THE AMERICAN SURGEON

Vol. 25, No. 10 October, 1959

Editorial

SURGICAL BACTERIOLOGY

Recent developments in the epidemiology of surgical infections and the recognition of the obvious limitations of antibiotic agents in their treatment have emphasized the fact that bacteriology is still an important field of surgery which must be recognized and served.

One of the serious adverse effects of the introduction and use of antibiotic agents in the practice of surgery has been the evolution of a blind reliance on the effectiveness of these agents and the belief that the problems of preventing and controlling most of the important surgical infections had been solved.

This attitude has naturally led to definite trends in clinical practice, the results of which have been deleterious in a number of ways. For example, the persistent trend toward extending prophylactic antibiotic therapy to every patient undergoing an operative procedure has contributed to the development of such problems as antibiotic sensitization of an increasing proportion of the population, the acquisition of antibiotic resistance by pathogenic bacteria in our environment, the emergence of antibiotic resistant staphylococci with unusual degrees of virulence and even with epidemic potential, the masking of infections, and the development of secondary or superimposed infections which are often more serious than the original condition for which the antibacterial therapy had been given. The realization that antibiotic prophylaxis has failed to decrease the incidence of postoperative infections by staphylococci and other bacteria and that effective prevention can't be bought by antibacterial agents, has emphasized the harmful and unnecessary aspects of these complications.

Furthermore, the occurrence of clinical failures has often led to another trend toward providing the widest and most complete antibacterial coverage possible through the use of either larger doses or combinations of agents.

Fortunately, these and other harmful effects of antibiotic therapy have received widespread recognition in recent months and corrective measures have been recommended by appointed committees of the American College of Surgeons, the American Medical Association, the American Hospital Association, the American Surgical Association and other organizations.

A more obscure but perhaps more significant effect of the blind reliance of clinicians on antibiotic therapy has been its influence on the bacteriologic aspects of surgical practice. A deemphasis of the importance of aseptic and antiseptic technique and an indifference to the proved principles of surgical care which had been established for the prevention of infections, have occurred and are persisting. Dressing and isolation techniques in particular have deteriorated noticeably and, as a consequence, active reservoirs of antibiotic resistant and virulent bacteria have been permitted to develop in hospitals throughout this country and the world.

Even less obvious has been the trend of clinicians to let the diagnosis of infections be made by laboratory technicians through cultures taken from the lesion, and to determine the method of treatment by means of the bacterial antibiotic sensitivity tests. Under these circumstances the cultivation of the hardier and more easily grown secondary bacterial invaders has resulted in many instances of mistaken diagnoses, misdirected treatment, extended morbidity, and unnecessary expense. At the same time the finer techniques of more definitive diagnosis, such as hanging drop preparations, biopsies, skin antigen tests and serum agglutination tests, have been neglected or

have disappeared from practice. The significance of changes in the white blood count and differential counts in the detection and identification of many infections has even been lost sight of, and it has been difficult to get surgeons, residents and interns to obtain and interpret such counts, even in teaching hospitals.

With these changes in attitude and conscience, it was natural that the training of surgical residents with special interests and talents in bacteriology should have lagged; and this has been the case.

These and other considerations have led us to the conclusion that the area of surgical bacteriology has been de-emphasized and neglected as one of the consequences of the use and misuse of antibiotic agents. The effects of a generation of surgeons having grown up under this philosophy probably will be felt in surgical practice for many years.

To correct such trends and their results, the re-establishment of surgical bacteriology to its relative importance is recommended. This could be accomplished by education of physicians, surgeons and medical students and by cultivation of a more realistic attitude of mind in keeping with our history, our heritage and the facts.

To nurture and maintain this attitude and to stimulate needed research, it would seem particularly important to provide special graduate training for selected surgical residents in the disciplines of bacteriology and immunology.

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IS THERE *A* ROUTINE CERVICAL SMEAR?

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Perhaps it seems only a little short of heresy for one who limits his practice to gynecology, obstetrics and related problems to suggest such a question. I admit that this question puts me on the defensive. "Why certainly," I tell myself, "every doctor and certainly every female specialist routinely takes a cervical smear!" And yet the question keeps coming back, "Does every doctor, does every specialist and, more closely, do I take smears on every female patient that I examine?"

Since attending a postgraduate course in gynecology 2½ years ago, I have been amazed at the lack of translation from the written word, which we receive so frequently in our medical journals, and the spoken word, which we hear at specialty and general type medical meetings, into information, practical for everyday usage in our office, where our knowledge is practiced.

The purpose of this paper is to collect and present a short description of several types of information which can be obtained from cervical smears. The particular idea in mind is to bring about the wider appreciation of the fact that there *are* routine cervical smears rather than there *is a* routine cervical smear. Also, I would like to show how easily these smears can be obtained and how inexpensively they can be performed. These factors would do much in activating a dynamic interest on the part of every physician who sees women patients. And, in the final analysis, our patients are the ones who benefit most greatly.

GONORRHEA

Too many physicians, as well as the general public, believe that gonorrhea is, like the whooping crane, almost extinct. Wasn't it a wonderful day when penicillin made its entrance into our society, for here was the cure of gonorrhea? Statistics for the fiscal year of 1958, however, indicate that in the southeastern United States alone, there were 16,629 proved cases of gonorrhea in the female.[6] There were approximately 270,000 cases during this 12-month period over the entire United States, of which only 25 per cent were proved cases. One of the difficulties in obtaining definite proof is that the gonococcus, in the past, has been cultured in the laboratories in order to definitely prove the condition and this has been time consuming. However, the Public Health Service states that perhaps before long we shall have a technique of fluorescent antibody tagging of the routine smear which will greatly facilitate the positive identification of the gonococcus. This will be quite an advance, and perhaps will enable all of us to become more aware that gonorrhea still exists and can be identified.

EVALUATION OF ESTROGEN EFFECT

The purpose of this procedure is to indicate the ovarian activity with a relationship between the estrogenic and progesterone portions of a menstrual cycle. It is of value in determining whether a young girl is nearing her menarche and also whether a woman in the postmenopausal era might benefit by, or be responding to, administration of estrogen therapy.

As in other features of cervical smears, the name Papanicolaou stands out as a forerunner. He correlated the study of cyclic changes of the cytology of the cervical and vaginal secretions with the follicle changes in the ovaries. He and Shorr described very different cellular changes in women who have passed the menopause from those women in the normal functioning years, and they were able to reverse these changes and replace them with a normal appearing pattern if an adequate amount of estrogen was used. A very simple technique was developed by Salmon and Frank who stained a dried vaginal smear with a fuchsin and alcohol stain and classified the estrogen effect into four classes which ranged from class I, indicating a severe estrogen deficiency, to class IV which revealed a normal estrogen effect. Class I cornification was characterized by absence of squamous epithelial cells and presence of small, round or oval epithelial cells with large darker staining nuclei and a minimum of absence of leukocytes. Another method, described by Mack, depended on the staining of glycogen in

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 10, 1959.

the cornified epithelial cells by the vapors over a dish containing Lugol solution.

I have been using the simple one-stage staining technique using a pinacyanole polychrome stain which is extremely simple to perform and takes approximately 1½ to 2 minutes. The procedure consists of rotating a cotton tipped applicator over the cervix or in the vaginal pool and then rolling it across the surface of a clean slide. Immediately, 4 to 5 drops of stain are placed on the smeared area and allowed to remain for 20 to 30 seconds. Then, 4 to 5 drops of water are placed on the slide and also allowed to remain for 20 to 30 seconds. The slide is then flushed with water. The under side of the slide is dried and the slide can immediately be placed under the microscope for examination. In my limited experience, I have found that this gives an excellent, sharp outline of the nucleus and cytoplasm. This procedure has assisted me to identify questionable cell structure which, when followed up by a standard Papanicolaou test, was sent to the pathologist for evaluation. Recently, I had a patient who, following this routine smear which I did in my office, was subsequently admitted to the tumor service of the University Hospital after the Papanicolaou smear was reported by the pathologist to contain definite tumor cells. The expense of this slide cannot exceed 5 cents and it takes only 4 to 5 minutes to prepare, stain and examine the slide under the microscope. This smear is also of value in demonstrating the progesterone effect on the vaginal epithelium, because it shows the estrogen-matured cells with small pyknotic nuclei to be sloughed off in rather large sheets or clumps.

CANCER DETECTION

We are constantly reminded of the prevalence of cancer; it attacks the young or old, rich or poor, literate or illiterate, married or single. Although it is apparently more prevalent in women who marry and have children before the age of 20, and less prevalent in women of the Hebrew race for reasons unknown, for every feminine member of our society whom this "Cinderella slipper" fits, the incidence for *that* individual is 100 per cent.

I was particularly intrigued by an article by Cassel[3] from the Department of Medicine of the University of Miami School of Medicine, and the Dade County Chapter of the American Cancer Society here in Miami, Florida, which appeared recently. With his permission I would like to quote a portion of one paragraph from this article:

"We physicians have many reasons and justifications for compromising with what we know is ideal practice. Some of these are rationalizations; others are truisms. Together, they sound like this: 'Time is limited'; 'There are so many pressures on us physicians'; 'Patients do not want to pay for a complete examination. Most of them want only patch work. They impugn our motives if we want to get other tests or opinions'; 'They disregard advice. They fail to follow through'; 'They don't appreciate our efforts in their behalf'; 'The yield is too small to examine every patient for everything.' "

It seems as though Dr. Cassel must have been eavesdropping in our section of the country. Strangely enough, I heard something to this effect when I was in Chicago and in Washington, D. C.; his idea must not be particularly unique to Miami. I wonder what is the real reason for our hesitancy at taking cervical or vaginal smears on every woman whom we examine in our offices at least once a year? Do we really believe that patients would object to paying from 5 to even 15 dollars a year in order to have a 95 per cent accurate diagnosis as to the presence of malignancy of the cervix?

Lund[12] described the particular efforts which had been made at the University of Rochester to keep accurate records of all expenses connected with utilities, rent, salaries, supplies and equipment involved in their survey of vaginal pathological smears. Over a 10-year period during which 132,071 slides were examined, the cost per slide was calculated to be 75 cents. This gave an average cost of $317 for each of the 312 cases of carcinoma of the cervix that were diagnosed from cervical smears. The incidence of carcinoma was 1 out of every 207 cases, whereas the incidence in a report from Memphis, Tennessee, was 1 out of every 136 patients. Certainly the diagnostic efforts in locating 1 wife and mother with cancer of the cervix are worth more than the price merely of a washing machine.

If ignorance of the particular technique required for cervical smears is the problem, then we certainly have a wonderful opportunity for some real missionary work within our own professional family. Perhaps some confusion is brought about by the numerous techniques advanced by the am-

bitious, diligent and perfectionistic men in research who have blazed the trail for us. How should I collect a smear? Should I use a cotton swab, a glass pipette with a rubber bulb on the end, a cotton or gauze tampon, or the very ingenious and most satisfactory wooden spatula to scrape the squamo-columnar junction? Really, the question should not be "Which one of these procedures shall I use?" but "How quickly can I apply the method which I understand?" Once we develop the habit of taking a smear on every patient, it is surprisingly easy to perform this simple procedure with a swab, a spatula, or even the end of the Grave's speculum on a clean glass slide, and dropping it immediately without allowing it to dry into a solution which in most areas can be obtained from a pathologist. One solution is 95 per cent ethyl alcohol, which is cheap, highly satisfactory and reusable after fixation. I prefer the pinacyanole stain which is placed immediately on the wet smear and which I can look at in my own office. Even if not close to a pathologist the physician can, with a comparatively small amount of equipment, identify features suggestive of malignancy such as: (1) basophilic staining of the nucleus, and acidophilic staining of the cytoplasm; (2) great irregularity in size of the cells; (3) eccentrically located nucleoli; (4) an increase in the size of the nucleus in relation to the size of the cytoplasm; and (5) multiple nuclei within abnormal appearing cells.

I wholeheartedly agree with Lund's[12] feeling that cytological smears should be used as: (1) an essential part of every gynecological examination; (2) an essential part of all semiannual or annual examinations; (3) a regular part or follow-up on all patients after treatment for malignancy, whether it was treated by x-ray or surgery; (4) a required part of the work-up on all patients being considered for hysterectomy; and (5) a part of the follow-up on all patients who have a cervical cone.

SPINNBARKEIT

Spinnbarkeit is a characteristic of the cervical mucus which, as its name signifies, indicates the ability of the mucus to be drawn out into a very fine thread after having been removed from the cervix with a glass cannula. The material is blown out onto a glass slide and a coverslip placed on it. By lifting the coverslip off the slide several times the length of the thread of mucus which is formed can be measured without difficulty and the average length can be obtained.

This property was originally described by Woodman and Hammond[24] in 1925 in a cow that was in heat; at other times the mucus was quite thick. Stevenson[17] gives a well documented review and describes the work of investigators who in 1933 stated: "When the mucus in the cervical canal is abundant, transparent, fluid and glairy, it is optimally penetrable by human spermatozoa and it becomes so at the time of ovulation." Even in 1868, Sims[16] had postulated: "In the investigation of a case of sterility if we expect to proceed understandingly we must determine whether the secretions of the cervical canal are favorable or not to the vitality of the spermatozoa." Obviously, as Cohen and associates[4] described, this feature is of particular value in barren couples who might be planning for artificial insemination.

At the time of maximal production of cervical mucus, which closely parallels the time of ovulation and which also closely parallels the time of maximal estrogen production by the ovarian follicles, the spinnbarkeit reaches a length of from 10 to 20 cm.; at other times, particularly just before ovulation, it will be impossible to draw out a thread longer than 1, or 2 cm. at the most.

I have found that one satisfactory test on cervical mucus consists of checking for the spinnbarkeit; then letting the mucus dry on the slide after removing the coverslip and examining it under the microscope, unstained, for its arborization or fern crystallization characteristics.

ARBORIZATION (FERN) PHENOMENON

This phenomenon demonstrates the ultimate in simplicity as a source of information which any doctor can evaluate. The only special equipment which the physician needs is a microscope and a vaginal speculum. It is a reaction which is found in other body fluids such as tear, nasal mucus and saliva and, as Zondek and Rozin[25] have described, it depends upon the presence of protein, carbohydrates, or electrolytes in order to form. They indicated that in the cervix, mucin and sodium chloride are involved.

Papanicolaou was the first to describe this phenomenon, in 1946. Numerous investigators have demonstrated that one of its remarkable features is that it occurs only in the presence of estrogen hormone activity. Zondek and Rozin

showed that this reaction is inhibited in the presence of progesterone and, therefore, it disappears usually within 24 hours and almost always within 3 to 4 days after ovulation. Up to the time of ovulation, after the termination of the menstrual flow, the ferning response becomes more intense and the branches of the crystals become thicker and more extensive throughout the entire smear.

The technique of this procedure consists of moistening the speculum with water and exposing it to the cervix. This is then wiped dry with a cotton ball, after which the cotton tipped applicator is inserted into the endocervical canal and rotated gently several times. The mucus is then placed on a clean glass slide and is allowed to dry in a fairly thick smear. The smear is then examined under the microscope, beginning with the low power and a low amount of light. Urdan and Kurzon[21] described the application of this phenomenon to four basic clinical problems.

1. *Adjunctive means of establishing diagnosis of early pregnancy.* In a series of 169 cases in which pregnancy was suspected because of clinical history and physical findings, 141 of these suggested pregnancy because of the presence of a dense, cellular pattern of the cervical mucus. The absence of a strong fern formation in a patient who has missed her expected menstrual period indicates the continuing effects of an active corpus luteum which is producing progesterone. In their series, 28 cases failed to show crystallization in the mucus and this conclusion of either the absence of a pregnancy or the presence of an unsatisfactory pregnancy was confirmed in every case.

2. *Differentiation between pregnancy and premenopausal amenorrhea.* In the late menopause the fern response is lacking. Cellular elements are loose, and many squamous cells from the portio are present, as opposed to the cylindrical cells of the endocervix in the younger individual. This indicates ovarian failure.

3. *Differentiation of primary and secondary amenorrhea.* If carried out once or twice weekly for a period of at least 6 weeks, the fern test will indicate the presence or absence of some ovarian activity. A well developed crystallization indicates follicular function of the ovary and, therefore, adequate stimulation from the pituitary. It also indicates the absence of ovulation and/or an unresponsive endometrium. But, if a good response is found, the efforts should be projected toward progesterone withdrawal type bleeding, since this indicates that the patient is receiving adequate estrogen stimulation. The absence of a good response during this 6-week period indicates that the patient is not obtaining adequate estrogen stimulation and would probably benefit from a cyclic estrogen and progesterone regimen.

4. *Establishing etiology of infertility.* When the point of greatest crystallization is followed by a mixed pattern, indications are that ovulation has occurred. Therefore, the physician could advise this time for coitus in the cycles that follow. Also the fluid portion of the smear, if examined before drying, would serve as an excellent Huhner test.

It has been suggested that the presence of a fern reaction in the mucus smear of a pregnant woman might foretell disaster for the pregnancy. Ullery[20] concluded that 30 per cent of all pregnant patients, at all stages, show some form of arborization and he did not feel that the presence of a fern reaction in pregnancy *necessarily* means placental insufficiency. He suggested also that a nasal smear may be a useful substitute particularly in cases where abortion is threatened.

There is one thought which I had regarding the use of a fern test in a postmenopausal patient. Because Van Smith[22,23] and Hertig and associates[10] reported an average of 85 per cent recurrence of cortical stromal hyperplasia in cases with endometrial carcinoma, we were cautioned that if any woman in the postmenopausal age showed evidence of cornification of the epithelium in the vaginal smear, chances are 1 in 6 that she has an endometrial carcinoma, because of the frequency of occurrence of the latter condition in the presence of ovarian follicular activity. I would like to suggest, therefore, that as a part of the pelvic examination of every postmenopausal woman, another "routine" cervical smear be taken for the purpose of observing for the possibility of a fern response. If this is found, then it is the responsibility of the examining physician to rule out a concomitant carcinoma of the endometrium.

NONSPECIFIC CERVICITIS

In the patients who have difficulties in reference to the cervix or who have sterility problems, the diagnostician must be aware of the nonspecific type of infections which frequently will show up in a simple Gram stain made on a smear from the pus or discharge from the cervix. This is mentioned briefly in this discussion, merely for the purpose of completeness, because in almost any of the procedures which we have discussed

so far regarding any type of stain, the presence of leukocytes in the smear will be quite evident. The Gram stain would indicate many leukocytes and also the presence of streptococci, bacillicocci, *Corynebacterium diphtheriae*, Vincent's spirillum which would appear as Gram-positive, and also short, coccus-like rods of which *Escherichia coli*, *Bacillus enteritidis*, and *Bacillus typhosus*, etc., are the most frequent offenders. All of these organisms are quite frequently found in a patient with Trichomonas infection as well.

TRICHOMONIASIS AND CANDIDIASIS

Although these conditions are generally diagnosed from material taken from the vaginal pool, they are being considered here for an attempt at completeness of our consideration of vaginal smears. *Trichomonas vaginalis* is the most common nonbacterial cause of vaginitis. Apparently, however, infection and disease are not necessarily synonymous, since an appreciable number of those who have the infection have neither signs nor symptoms of any disturbance from it. Various reports[1, 2] have suggested that the prevalence of this condition ranges from 15 to 40 per cent of all women. However, apparently 20 to over 60 per cent of women who have the infection of Trichomonas are completely asymptomatic carriers. Of course, it is possible that these carriers might develop symptoms and require treatment later and the treatment required might perhaps range from chemotherapeutic agents to psychiatric advice.

In the diagnosis of trichomoniasis, 1 drop of material from the cervix or from the tip of the examining speculum is placed on a slide and a coverslip placed on top of it. It is examined under the low power objective of the microscope for rounded or pear shaped objects from 15 to 30 micra in diameter which are capable of moving themselves with a whipping movement of the flagella. Donné discovered this organism in 1836, and even today it is still not thoroughly understood. It is classified as a protozoan capable of independent motion which seems to be most satisfactorily nourished in the presence of blood. This could account for the apparent increase in severity of symptoms during and after the menstrual period. One word of caution, however, to all of us in this problem of diagnosis and that is, as in any case of vaginal discharge, the patient should not douche for 48 hours preceding examination.

Infection with *Candida albicans* (more commonly called Monilia) is produced by one of the yeast fungi closely related to the fungus which produced thrush in infants. In a recent article[18] from the Obstetrical and Gynecological Clinic at Jackson Memorial Hospital, cultures from 500 consecutive new patients at the clinic from August to December 1956 produced a positive culture for Monilia in 29.5 per cent of obstetrical patients and 17.4 per cent of gynecological patients. This is almost the same incidence as is seen in northern climates. The symptoms of Monilia and discomfort associated are so severe that generally the patient does not let the condition go untreated as long as she might with trichomoniasis.

From the smear, the Candida may be recognized as a thin walled, oval, yeastlike structure measuring from 2 to 4 micra. Budding cells are seen and occasionally a mycelium with budding cells attached at the point of constriction may be seen either if examined first or using a Gram stain. The fungus is Gram positive. Diagnosis may also be made by the hanging drop technique in 10 per cent sodium hydroxide.

This condition is frequently found in pregnancy, diabetes, and often might follow heavy doses of a broad spectrum antibiotic of the tetracycline category to which an inhibiting agent has not been added.

RADIATION RESPONSE AND SENSITIZATION RESPONSE

The final subject for consideration will be two features of smears which will probably not be widespread in their usage but will serve to stimulate imagination and realization that the study of cells probably holds the key to the diagnosis, treatment and prognosis of malignancy.

Numerous methods have been used to indicate the degree or ability of response of a malignancy to various types of treatment. Biopsies during radiation therapy have been used but are difficult to obtain and there is concern in some circles over the possible harmful effect of repeated incision into the tumor and surrounding tissue during x-ray therapy. Perhaps a vaginal smear can escape these two objections because (1) it is easy to obtain and (2) it is not traumatic.

During radiation therapy the following characteristic changes occur in the nonmalignant epithelial cells, in order of frequency: (1) cytoplasmic vacuoles; (2) increase in cell size; (3) multiple nuclei; and (4) alteration in the nuclear appearance.

Vacuoles in the cytoplasm are seen first and most frequently in the basal cells and are rarely seen in the nucleus. Increase in cell size affects both nucleus and cytoplasm and apparently represents growth rather than edema. Cells are considered to be enlarged when they become at least 30 per cent larger than normal, and some cells even achieve a size 10 times the normal diameter. The most common nuclear change is the wrinkling of the nucleus, which seems to indicate that the contents of the nucleus are less than would be required for a nuclear wall. Also, the chromatin pattern in the nucleus becomes arranged in large clumps or strands rather than evenly distributed. And often from 2 to 4 nuclei are visible in cells exhibiting the radiation response.

The significance of these changes is considered by making a differential count on 100 consecutive nonmalignant epithelial cells and expressing the results as a percentage. These smears are generally taken daily or sometimes 3 times a week during radiation therapy and the results are charted. It has been shown that patients who attain a level of 70 per cent of cells which show this radiation response (RR) have a much better prognosis than those who have 69 per cent or less. On a series which was run by Graham and Graham,[8] a 5-year cure rate of 65 per cent was found in patients with a good RR but an average cure rate of only 10 per cent for 5 years or longer was found in patients who had an RR of 69 per cent or less. With their technique radiation therapy would be given in a divided dose with an interim of 2 weeks before the administration of the second radium application or before completion of full pelvic x-ray therapy. If the RR was unsatisfactory, elective radical surgery would be considered immediately. This was the basis on which Meigs, at the Vincent Memorial Hospital in Boston, was conducting his treatments of patients chosen to begin therapy with x-ray. Neilsen, in Copenhagen, has observed a 5-year cure rate of 68 per cent with a good RR but only 20 per cent with a poor RR. Also, Kjellgren, in Gothenburg, reported a 72 per cent 2½- to 5-year cure rate with a good RR but only 37 per cent cure rate with a poor RR.

The sensitization response (SR) is a feature of the basal cells of the nonmalignant epithelium which has been described in some patients with cancer of the cervix before treatment. In a sense, this response resembles the RR but according to some authors it exists before radiation therapy and has been interpreted as a host reaction which suggests a resistance of the body which perhaps has partially held a tumor in check. The features of the SR are a finely vacuolated cytoplasm which is increased in density and stained a deep lavender color with Papanicolaou's polychrome stain. In its use, a differential count is made on nonmalignant epithelial cells. With the SR the critical level is 10 per cent and if it is observed in more than 10 per cent of the nonmalignant cells the response is described as being "marked" and the patient will apparently do quite well on radiation. In one series of 53 patients with all stages of malignancy who had a good SR, 72 per cent were living and well at the end of 5 years. If less than 10 per cent of the cells show this SR, then they are described as showing a poor SR, and in the same series only 15 per cent of those patients with a poor SR lived 5 years.

On the other hand, it was found that patients with a poor SR do well when treated surgically. In a series of 57 patients who were treated surgically and who had shown a poor SR, 71 per cent were symptom free from 2 to 5 years later. In the same series, only 39 per cent of patients who had shown a good SR previously, and who subsequently were treated by surgery, were symptom free for the 2- to 5-year period.

Therefore, it seems that particularly with stage 1 and stage 2 lesions, which were divided according to SR and the method of treatment, those patients with a poor SR do well when treated surgically and those with a marked SR do equally well when treated radiologically. The results were just the opposite when the SR was poor and x-ray therapy was used, or when the SR was marked and surgery was used. Graham and Graham[8] have correlated that patients with a poor SR have a low incidence regional metastases (18 out of 104 cases or 17 per cent), and those patients with a marked SR have a high incidence of regional metastases (21 out of 33 cases, or 64 per cent).

These studies seem to suggest that if ample training were available to enough trained personnel, the SR phenomenon may be of great value in the selection and application of treatment and, also, may indicate a host factor that would be of importance in the prognosis of a particular case after treatment. The finding that a good SR in a younger patient would seem to indicate a better prognosis with radiation therapy than it does with an older patient, is reported. It also seems that the original smear taken on a patient who is subsequently treated by radical hysterectomy for cervical carcinoma is of great prognostic value. If the original smear before operation contains numerous basal cells (above 50 per cent), a poor prognosis is suggested; whereas a significant increase of basal cells after radical hysterectomy is indicative of a favorable prognosis, according to a report by Liu.

SUMMARY

1. The simple procedure of obtaining several "routine" cervical smears cannot be praised too highly.

2. Cervical smears, requiring a minimal amount of expense and laboratory effort, may be of immense value in detecting gonorrhea, estrogenic activity of the ovary, the presence of cervical cancer, spinnbarkeit, arborization of the cervical mucus (fern test), nonspecific cervicitis, and Trichomonas and Monilia infections.

3. The radiation response and the sensitization response require a little more effort but perhaps will produce a great deal more information.

4. Smears for the detection of cervical carcinoma *cannot* be too greatly emphasized and should be a part of every woman's annual or semiannual pelvic examination.

5. The spinnbarkeit and fern reactions can, together, contribute much information to every physician and be of much benefit in the conduct of proper evaluation of infertility.

6. The presence of cornified epithelium or a positive fern reaction in a postmenopausal woman should be the same as the delegation of the responsibility to the doctor to locate the source of estrogen and prove that it is not existing concomitantly with carcinoma of the endometrium.

7. We physicians should take the cervical smears with whatever technique we choose but, regardless of which technique we choose, we should take cervical smears routinely.

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ADVANCES IN TREATMENT OF CANCER OF THE COLON AND RECTUM

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A discussion of surgery of the large bowel assumes the division of this organ into the right and left halves which are anatomically, physiologically and embryologically different structures. The right half, derived from the midgut, is supplied by the superior mesenteric artery and is predominantly an organ of absorption,[9] whereas the left half, derived from the hindgut, is supplied by the inferior mesenteric artery and is predominantly an organ of storage. Pathologically, lesions of the right and left halves of the colon are also distinctive, with characteristics which are peculiar to the portion of the colon from which they originate. Lesions of the right side, which are usually of the fungating, cauliflower type, produce anemia and weight loss but rarely obstruct; on the other hand, those of the left side are annular in shape, encircle the bowel rapidly and produce symptoms of obstruction.

This difference in embryology and anatomy of the two sides results in a different pattern of lymphatic drainage (fig. 1). In the right colon the chain of lymphatics follows the course of the ileocolic, right colic and middle colic arteries toward the base of the mesentery, whereas in the left colon, drainage is principally along the course of the inferior mesenteric artery. At the base of the mesentery the two systems merge to form the portal chain to the liver,[15] thus explaining the frequency of early liver metastasis. When tumor cells block the usual direction of lymphatic drainage, the cancer cells spill into the paracolic circulation and spread along the aorta. These peculiarities of the lymph and blood supply have a profound influence on the type of surgical procedure instituted on the various portions of the large bowel in which carcinoma occurs. Because of the common and single blood supply, lesions of the cecum, the ascending colon and the hepatic flexure require removal of the distal ileum, the entire ascending colon and half of the transverse colon. Also, because of its single blood supply, surgery of the right colon is necessarily radical and this in part accounts for the higher survival rate in lesions of this area (fig. 2).

We are partial to the end-to-end anastomosis. The small bowel is cut slightly on the bias; we are very cautious to preserve the blood supply of the two segments. The open anastomosis is preferred because we feel that, although the neatness and mechanical features of a closed type of anastomosis are attractive to watch, the open method is more accurate and reliable. It is not so much the soiling at the time of operation that is to be feared, but rather the continued leaking after the abdomen has been closed.[12] A proximal ileostomy is not deemed necessary and we rarely institute nasal suction.

Lesions of the transverse colon constitute a small percentage of the cancers of the large bowel, approximately 3.8 per cent (fig. 3).[8]

If obstruction is not present, adequate bowel preparation is carried out and a wide resection is done, including mesentery and proximal lymph nodes, with the transverse colon, hepatic and splenic flexures. When the splenic and hepatic flexures are mobilized, the mesentery and bowel can be carried downward and the anastomosis easily performed. A primary end-to-end anastomosis is done unless there is obstruction, perforation, inflammation or abscess formation. If obstruction is present the lesion can usually be located by a flat plate of the abdomen or, if necessary, we do not hesitate to use a barium enema to locate the lesion. Decompression is carried out when indicated by a blind cecostomy or proximal colostomy. The patient is then prepared and a primary resection performed.

In lesions beyond the transverse colon, including the splenic flexure and descending colon, many follow the recent trend of Wangensteen[25] and Pack.[22] They advocate the more radical procedure of a total colectomy with anastomosis of the ileum to the sigmoid or rectosigmoid, thus re-establishing the continuity of the bowel and control of the fecal flow by a single stage, primary resection. This has been considered one of the most recent advances in the radical cure of carcinoma of the bowel, and some improvement

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 11, 1959.

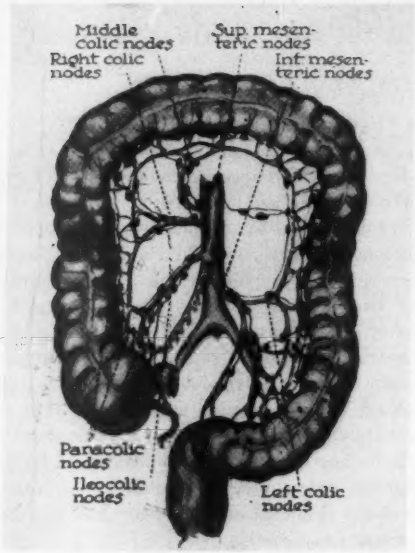

FIG. 1. The lymph drainage of the colon. These lymphatics mainly follow the course of the chief blood vessels. Most of the lymph drainage is to the group of glands located around the upper part of the superior mesenteric artery; from here the efferent vessels drain to the main intestinal lymph trunk.

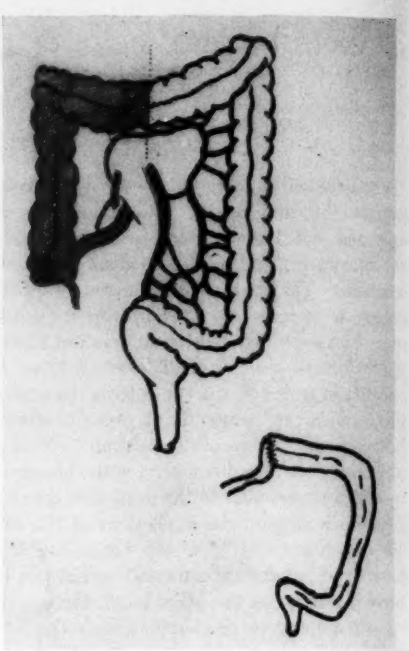

FIG. 2

in the 5-year survival rates in lesions of this area can be demonstrated because of the wider removal of the lymphatic drainage. However, we believe this is an excessively radical procedure in many instances. It would seem that in an early lesion without palpable, demonstrable or microscopic node involvement, a fairly wide removal of the transverse colon (as shown in fig. 4) with removal of the splenic and hepatic flexures would be an adequate operation.

When the question of operability arises, it is well to remember the aphorism of Edward Trudeau: "To cure sometimes, to relieve often, to comfort always." Therefore, with large lesions and obvious metastasis, we do a palliative resection to re-establish the continuity of the fecal stream and keep the patient comfortable until his demise.[22] Death from the relatively painless inanition produced by liver or other distant metastases is certainly a great improvement over the constant pain, exhaustion, diarrhea, bleeding and tenesmus resulting from a lesion left in place with a proximal colostomy. Colostomies in these people are a nuisance. They are messy, filthy curses inflicted upon the surgical patients with

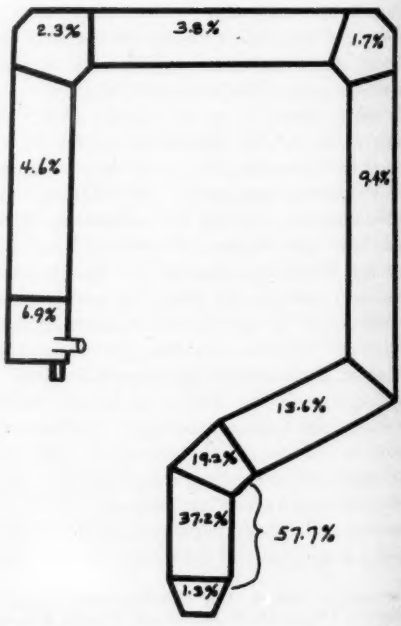

FIG. 3. Location of the tumor of the large bowel.

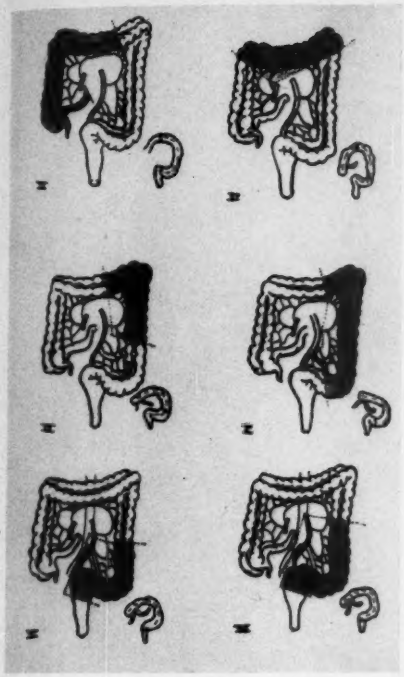

FIG. 4

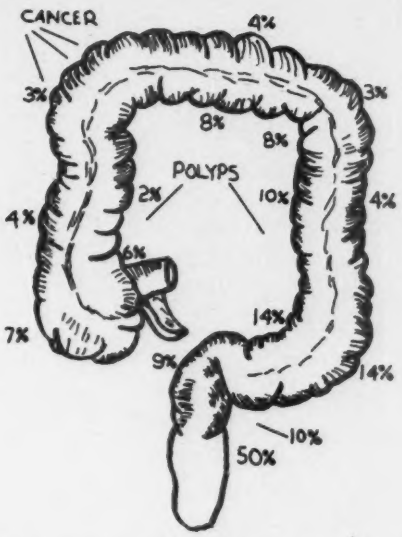

FIG. 5. Comparative distribution of cancer and polyps in the large bowel.

no reason for the fecal stream being diverted to his abdominal wall when the continuity of the bowel can be re-established with 20 to 30 more minutes of surgery. Metastatic lesions will practically always end the person's life before local recurrences have occurred.[14]

One of the definite purposes of this paper is a plea for fewer colostomies. As experience and time progresses we find that permanent colostomies and stage operations are not so frequently necessary or justifiable. Less than 20 per cent of all carcinomas of the bowel which are operated upon for cure require a permanent colostomy. In other words, 80 per cent of all operations done on the large bowel and rectum can be carried out with satisfactory assurance of a cure without the terrible morbidity, inconvenience, and nuisance of a permanent colostomy.[27]

Seventy per cent of carcinomas of the large bowel occur in the lower descending colon, sigmoid, rectosigmoid and rectum,[11] and are within the reach of the examining finger and the long proctosigmoidoscope.[23] Therefore this area should be given preferential consideration. This is the area where many of the controversies over the proper treatment occur. This is the area that we will give special emphasis in our plea to change some of our surgical principles and techniques and leave these patients with normal bowel control.

Let us reiterate the almost universally accepted conclusion that the story of carcinoma of the colon and rectum is the story of the life cycle of the polyp.[10, 11] Although absolute proof is lacking, both direct and indirect evidence have led us to the convincing conclusion that practically all malignant growths of the large bowel develop on the basis of the polyp (fig. 5).[29] We know that if these polyps remain in the colon long enough, eventually they will undergo malignant degeneration and produce a cancer of the large bowel. Evidence of this conclusion is as follows:

1. A striking parallel exists in the distribution of polyps and carcinoma.[10]

2. Multiple carcinomas of the large bowel occur in 4 to 5 per cent of cases indicating multicentric foci of origin.[3]

3. Carcinoma is found in 66 per cent of cases of multiple polyposis.

4. Microscopic cancer *in situ* is commonly found in grossly benign polyps.

5. Polyps occur frequently in association with carcinoma of the large bowel.[24]

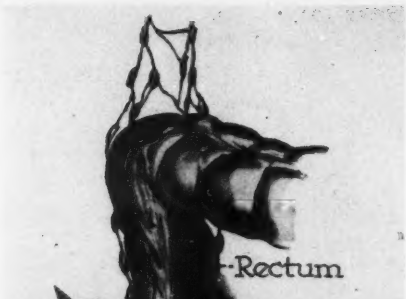

FIG. 6. The lymphatic drainage of the rectum. The arrows indicate the three zones of lymphatic spread. Zone *1* travels upward; zone *2* lateral, between the pelvic fascia and the levator ani muscle; zone *3* spreads downward.

6. Carcinoma of the large bowel not infrequently assumes a telltale polypoid form.

The treatment, then, of multiple polyposis consists of a colectomy with ileosigmoidoscopy when the polyps are numerous. When they are few, of course, they can be removed by multiple incisions in the bowel, using the sterile proctoscope. The remaining polyps, after total colectomy, are treated through the proctoscope.

Preparation of the patient consists of: (1) careful history and physical examination and routine laboratory tests; (2) complete x-ray survey of the entire gastrointestinal tract and chest; careful evaluation of the blood chemistry, blood volume and red cell volume; high carbohydrate, high protein diet, plus supplementary vitamins; (3) cardiovascular evaluation; (4) sulfathaladine, given in doses of 8 gms. daily, in divided doses, over a 5-day period; (5) 48 hours before surgery, neomycin, terramycin or erythrocin, given in doses of 250 mg. every 4 hours; (6) vitamin K given throughout the preoperative period because suppression of *Bacillus coli* interferes with the absorption of vitamin K and, consequently, with the hepatic production of prothrombin; (7) purges not used but vigorous colonic irrigations are used the day and night before and the morning of the operative procedure.

After proper preparation, a radical, wide, single stage resection is done in all lesions down to the peritoneal reflection. In nearly all cases it is necessary to go back to the aorta and remove the inferior mesenteric vessels and nodes. However, in low lesions, which are small, with no metastases, no extension, and no penetration, it is not always necessary to go back as far as the aorta.

In lesions at or below the peritoneal reflection, there have been many and varied opinions regarding the type of procedure that yields the best results. Based on longevity, preservation of function, comfort of the patient and removability of the lesion,[18] one may choose from three types of procedures (fig. 6): (1) the combined abdominoperineal resection of Miles; (2) the low anterior resection; and (3) some type of sphincter-saving, pull-through operation.

It should be remembered that the 5-year survival rate is lower for patients who have lesions of the distal two-thirds of the rectum than for those who have lesions of the upper third and lower part of the sigmoid. Lateral lymphatic spread and local extension to the bladder, prostate, or vagina make it difficult to eradicate surgically the disease in the lower third of the rectum. Many feel that the radical Miles' procedure is the operation of choice for lesions from the peritoneal reflection down to and including the anus. To this has been added a more radical innovation by adding iliac and obturator node dissections in continuity with the rectum.[15] However, the Miles' procedure with the inevitable colostomies is being used less and less. With long experience and statistic data, we are finding that the mortality and morbidity rates are showing that the comfort of the patient can be greatly increased without the inevitable curse of the colostomy or increased mortality. We know that 80 per cent of the people that are operated upon for carcinoma of the rectum, rectosigmoid and anus have a chance of cure at the end of the operation;[27] 50 per cent survive for 5 years, 20 per cent cannot be cured at the time of operation and of these 10 per cent can have a palliative resection, and only 10 per cent require a permanent colostomy.

Operations are being planned for wider and more extensive removal of the lymphatic drainage of the carcinoma, but we know this is not the entire picture. Venous spread must also be taken

into consideration, resistance of the patient to cancer, resistance of the peritoneum to implants, resistance of the patient to metastasis. Black and Waugh[5] have shown that the retrograde spread of carcinoma is only in millimeters. In a large series of their cases only 1 patient had levator involvement. The carcinoma does not tend to invade the levator ani but pushes the levators away from the carcinoma. It is the distance of the lesion from the levator ani that is important in planning the surgical operation to be performed and not the distance from the variable peritoneal reflection.[16]

The Miles' procedure, all agree, is the only safe operation to be performed in lesions up to 5 cm. above the pectinate line. It has been demonstrated that lesions within 2 cm. of the pectinate line will have 40 per cent involvement of the internal sphincter which is part of the musculature of the bowel wall. Lesions 10 cm. or above the pectinate line can be adequately removed with a low anterior resection, with a 65 per cent[20] 5-year survival. This is a higher survival rate for lesions at this location than can be claimed with a Miles' abdominoperineal procedure. In the controversial area, therefore, between 5 and 10 cm., some type of sphincter-saving, pull-through operation is becoming more popular and is surgically feasible.

The Bacon operation of preserving the external sphincters is one of the popular procedures. However, with lesions from 5 to 7 to 10 cm., above the pectinate line, the Swenson or Welch-Rheinlander type of procedure is excellent without sacrificing good control of the fecal stream. An anastomosis done with 1 cm. of rectum and an intact anus will result in good control.

A third type of procedure is the endorectal resection of Black and Botham.[6] In this operation a ligature is placed below the lesion, the bowel dissected to the perineum and the bowel pulled through the incised rectum and permitted to adhere to the serosa of the sigmoid or descending colon. The results of this operation are similar to those of the Swenson procedure.

In a large series of cases over the past 13 years presented by Waugh, Bacon, Black and others, there is a 65 per cent 5-year survival rate in the anterior resections, a 53 per cent survival of pull-throughs, and a 50 per cent survival in the Miles' type of procedure. This, we think, is very gratifying. These patients are much more

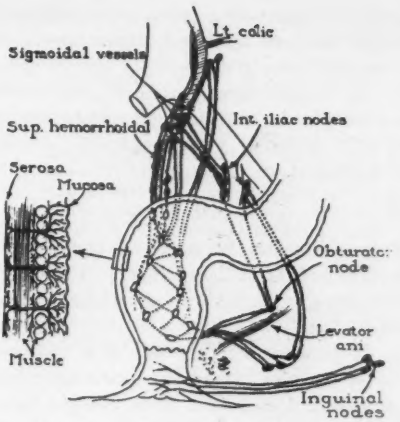

FIG. 7. The extramural and intramural lymphatic systems of the rectum (intramural system after Leitch). (From Glover and Waugh: Surg. Gynec. & Obst., vol. 82.)

comfortable, their bowels move in the usual manner and they have almost complete control of their fecal stream. However, there are complications of the pull-through operations. Four principal ones are:

1. Twenty-six per cent will have urinary incontinence and this is the same percentage that occurs with the Miles' procedure.[17]

2. Twenty per cent will have presacral infections and this is practically the same as in the Miles' procedure.

3. In approximately 13 per cent of the cases, retraction and slough of the bowel will occur, the most feared complication of the pull-through operation; however, a permanent colostomy is rarely required.

4. Occasionally, one will have delayed prolapse of the rectal mucosa which usually results from insufficient mucosa being trimmed off in the first place; this is easily corrected.

Wangensteen and others have advocated the "clean-up" or "second look" principle. If such an indication exists it is in carcinoma of the colon; 6 months after a resection is done, a second look is taken and all metastatic glands or evidence of recurrence are removed. This is carried out at intervals until there is a negative exploration. Wangensteen has taken as many as eight "looks" into one individual before no recurrences were found. This is radical surgery but it is the only treatment and hope of cure in the killing disease of cancer.

Some are advocating pelvic exenterations for selected cases of advanced carcinoma of the rectum and rectosigmoid without distant metastasis. These procedures with their wet colostomies, ileobladder or cutaneous transplant of ureters, I leave to your judgement, selection and conscience.

SUMMARY

During the last 10 years we have evolved several principles in the treatment of carcinoma of the large bowel that we have followed quite consistently:

1. As soon as the diagnosis of a malignant lesion of the colon is made, no unnecessary delay is permitted. A malignant lesion changes from a curable lesion to an incurable process at some second of some minute of some hour of some day.

2. A more extensive and radical removal of bowel, mesentery, lymphatics and blood vessels.

3. Better preparation of the patients to permit open anastomosis.

4. End-to-end anastomosis rather than side-to-side anastomosis.

5. Primary resection with no proximal decompression unless indicated.

6. Low, anterior resections are done whenever possible, down to the peritoneal reflection. The Mikulicz and Rankin obstructive resections have almost become a thing of the past.

7. Palliative resections, even in the face of very extensive metastases, to avoid the complications and inconveniences of colostomies.

8. Primary total colectomy in the prophylactic treatment of polyposis of the colon.

9. Sphincter-saving, pull-through operation in lesions at or above 5 cm. from the pectinate line. The Swenson, Marden Black or Bacon-Babcock type of operation is used.

10. Miles' procedure only for lesions up to 5 cm. above the pectinate line.

11. All hemorrhoidectomies have a routine sigmoidoscopy and barium enema before surgery. It is surprising to learn the number of carcinomas which have been treated for 6 months to a year as hemorrhoids and yet have not had the benefit of a digital examination, sigmoidoscopy or barium enema.

12. Second look or clean-up principle.

13. A plea to reduce the number of social outcasts who are cursed with a colostomy that may not have been necessary.

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OPERATIVE *VERSUS* NONOPERATIVE TREATMENT OF MASSIVE HEMORRHAGE FROM PEPTIC ULCER

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The optimal treatment of acute massive upper gastrointestinal hemorrhage from peptic ulcer remains one of the great problems confronting physicians and surgeons. Numerous reports appear in the recent literature concerning this problem.[2, 4-10] The surgical mortality is still high in spite of improvements in methods of blood replacement and techniques of anesthesiology and the use of antibiotics.

During the past quarter century there has been a trend toward a more aggressive approach to the treatment of these patients. Early surgical intervention has been recommended by many authorities. The lack of impressive improvement in the over-all mortality during a period when surgical mortalities have generally declined lends little support to this approach. Welch and associates,[9] in reporting the cases from the Massachusetts General Hospital between 1923 and 1953, record a mortality rate of 13 per cent. They noted that between 1948 and 1953 the mortality rate had risen to 17 per cent. This was attributed to the advanced age of patients, but the increase in mortality may have resulted in part from a more aggressive approach to these patients. Karlson and associates,[4] in a comparative study of alternate patients treated by the ultraconservative method of Andresen,[1] the aggressive surgical approach of Stewart and associates[7] or the selective method of Hoerr and associates,[3] found the mortality rate to be essentially the same in each of the three groups. Mixter and co-workers[6] reported a mortality of 12 per cent between 1928 and 1937 with nonoperative management. Between 1946 and 1952, with the frequent employment of emergency gastrectomy, this rose above 20 per cent and between 1952 and 1956, with strict and careful selection of candidates for surgical intervention, this was reduced to 9 per cent.

Selective gastrectomy has been utilized in the treatment of massive upper gastrointestinal hemorrhage at the Medical College of Virginia Hospital; whereas at the Johnston-Willis Hospital a nonoperative approach during the acute phase of hemorrhage has been utilized almost exclusively. The purpose of this study is to evaluate both forms of therapy and to attempt to arrive at some conclusions from a comparison of the two. The Medical College of Virginia Hospital serves as the city hospital for Richmond and draws patients, private and ward, from a large section of the state. In addition, the hospitals serve the medical school for both undergraduate and postgraduate instruction. The Johnston-Willis Hospital, also located in Richmond, by contrast is an all private institution with a small and constant staff. Many things, including state of nutrition, previous therapy and the time medical attention is first sought, tend to create differences between ward and private patients. Significant, too, is the racial factor. The Medical College series contains 47 per cent Negroes whereas the Johnston-Willis series has none. This study is made with full realization of these differences.

The treatment at the Medical College of Virginia Hospital consisted of bed rest, antispasmodics, antiacids, frequent feedings, opiates and sedation. Transfusions were given in sufficient quantities to restore and maintain normal blood pressure. Nasogastric suction was utilized in those cases in which vomiting was significant. The following conditions were considered indications for surgery: (1) failure of the blood pressure to stabilize after the administration of 1500 cc. of blood, (2) failure to maintain blood pressure with 500 cc. of blood every 8 hours, (3) continuing hemorrhage after 48 hours of treatment, (4) recurrence of hemorrhage while in the hospital on a medical regimen, (5) the existence of concomitant complications such as pyloric obstruction, which made medical therapy impractical or ineffective. Surgical treatment generally consisted of subtotal gastrectomy after blood replacement. A similar form of conservative therapy was utilized at the Johnston-Willis Hospital. However, conservative therapy was continued and operation during the acute phase of bleeding was never employed.

The selection of cases from both groups was standardized. Records of cases with hemoglobin below 60 per cent (9 gm.) caused by acute blood loss occurring within 7 days of admission, and with a peptic ulcer that could be demonstrated by x-ray, at surgery or at postmortem examination, were acceptable for the study. During the period of 1947 to 1957 inclusively, 136 such cases were collected from the Medical College of Virginia group (table 1). The average age of these patients was 52. The youngest was 17 and the oldest was 84. The average admission hemoglobin was 49 per cent (7.4 gm.). Of these patients 47 per cent were Negroes. There were 17 deaths, with an average age of 65. Of the 17 deaths 11, or 65 per cent, occurred in Negroes. Of the 17 patients who died, 8 were not treated surgically. In a total of 136 patients, 62 per cent were ward cases and 65 per cent of the deaths occurred in this group.

The mortality rate was significantly higher in gastric than in duodenal ulcers. There were 7 deaths among the Medical College of Virginia gastric ulcer group (table 2). A total of 33 of the 136 patients were treated surgically during the active phase of hemorrhage. Subtotal gastrectomy was performed in 31 cases; in 1 case a vagotomy was done in addition to gastrectomy, and in still another a sleeve resection was performed on an elderly, poor-risk patient with a gastric ulcer. The oldest patient treated surgically was 83 and the youngest was 19. There were 2 fatalities in the less than 50 age group in whom surgical intervention was utilized. One of these, a woman of 33, had severe renal and liver disease in addition to the peptic ulcer. The other, a man of 38, following gastrectomy with excision of a duodenal ulcer, hemorrhaged postoperatively from a second ulceration in the duodenal stump. This death could be directly attributed to exsanguination as proved by postmortem examination. No deaths occurred in the patients below 50 years of age who were not operated upon. In the over 50 age group 31 were treated surgically with 7 deaths, whereas 53 patients were treated conservatively with 8 deaths.

During the same period 117 similar patients were treated at the Johnston-Willis Hospital (table 3). The youngest of these was 18 and the oldest was 89. The average age was 52. The average admission hemoglobin was 50 per cent (7.5 gm.). There were 4 deaths in this group; the average age of those who died was 64.

TABLE 1

Selective gastrectomy series (Medical College of Virginia)

	Total
Gastric ulcer	
Over 50 years of age	16
50 years of age and under	3
Stomal	
Over 50 years of age	5
50 years of age and under	1
Duodenal	
Over 50 years of age	54
50 years of age and under	57

TABLE 2

Selective gastrectomy series (Medical College of Virginia)

Location of Ulcer	No. of Cases	Operative Deaths	Nonoperative Deaths	No. of Deaths*
Gastric	19	4	3	7
Stomal	6	0	0	0
Duodenal	111	5	5	10
Total	136	9	8	17

* Mortality rate, 12.5 per cent.

TABLE 3

Conservative therapy series (The Johnston-Willis Hospital)

	Total
Gastric ulcer	
Over 50 years of age	14
50 years of age and under	1
Stomal	
Over 50 years of age	2
50 years of age and under	0
Duodenal	
Over 50 years of age	51
50 years of age and under	49

The Johnston-Willis Hospital group consisted of 100 duodenal, 15 gastric and 2 stomal ulcer cases (table 4). Two of the 4 deaths occurred in patients with gastric ulcers. The 2 remaining deaths occurred in patients with duodenal ulcers. All 4 deaths in this group were over 60 years of age.

Of the initially nonsurgical patients at the

TABLE 4

Nonoperative series (The Johnston-Willis Hospital)

Location of Ulcer	No. of Cases	No. of Deaths*
Gastric	15	2
Stomal	2	0
Duodenal	100	2
Total	117	4

* Mortality rate, 3.4 per cent.

Medical College of Virginia, 16 have subsequently undergone elective gastrectomy. No deaths have occurred in this group. Of the patients not operated upon, 18 have been readmitted because of recurrent hemorrhage. At the Johnston-Willis Hospital 23 of the duodenal ulcer patients and 7 of the gastric ulcer patients underwent gastrectomy during their initial hospitalization. There was no mortality in this group. Of the patients not operated upon, 5 have been readmitted because of recurrent hemorrhage.

SUMMARY

1. A remarkable similarity with regard to age, location of ulcer, and admission hemoglobin levels has been established between two groups of patients. Inherent discrepancies between them, some of which are not amenable to quantitative analysis, are acknowledged. Despite these discrepancies more favorable results with nonoperative therapy during the acute phase of the hemorrhage seems apparent. It should be emphasized, however, that 8 deaths in the selective series occurred in patients not operated upon. Since operation is generally selected for severe or persistent hemorrhages, the need exists for emergency gastrectomy in some cases. The findings point to the need for more critical selection of these cases and to the difficulty in reaching an early decision as to whether surgery will be necessary in a given patient.

2. More prolonged medical management seems to be indicated, with surgical intervention being reserved for those cases in which it is necessary as a life saving procedure, or in which it seems obvious that conservative treatment will be unsuccessful.

3. Elderly patients, especially those with a gastric ulcer, are less likely to respond to conservative therapy and should be considered more strongly for immediate gastrectomy.

4. Death due to exsanguination in patients under 50 years of age with peptic ulcer is extremely rare with proper medical treatment.

5. The mortality rate is higher in hemorrhage from gastric ulcers than from duodenal ulcers.

6. The fatalities which occurred both in the operative and nonoperative patients have been associated with coronary occlusion, renal ischemia, hepatic failure, aspiration pneumonia, atelectasis, pneumonitis, cardiac arrythmia and congestive failure.

7. Gastrectomy following cessation of hemorrhage and restoration of blood volume is a comparatively safe procedure and should be utilized in the prevention of recurrent hemorrhage.

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RIGHT-SIDED PAIN CAUSED BY ADHESIONS OF THE COLON

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The most common complaint of patients seen by the general surgeon is pain in the right lower quadrant. When one considers that approximately 365,000[14] appendectomies are done in the United States each year, and that 30 per cent of these are pathologically normal, or chronically inflamed, if the pathologist is kind, we have the source of common conflict between the surgeon and Hospital Tissue Committees. The surgeon is at a disadvantage because he cannot present a satisfied and pain free patient in evidence, whereas the pathologist's report becomes the permanent and official record of the hospital.

This presentation is an attempt to point out again a common cause of right-sided pain that is frequently overlooked, both in practice and in the literature.

Much has been written about the developmental anomalies of the colon, including those of rotation and descent, length and size, fixation and range of mobility.[13] No attempt was made to link these factors to abdominal pain until Lane,[10] discussing the membranes supporting the ascending colon, stated that these membranes frequently produced interference with the free passage of intestinal contents through the colon. He believed that appendiceal inflammation was due to this obstruction and was a secondary manifestation.

In 1909 Jackson[8] drew attention to the futility of expecting a clinical cure in patients complaining of chronic right lower quadrant pain by simple appendectomy when constricting bands of the ascending colon were present.

In 1918 Harvey[7] presented an excellent review and study of various membranes encountered in the right half of the colon. He stated that the cecum, in its descent, occasionally drew membranous folds down with it; apparently they are not true peritoneal folds because they are vascular, and when they are cut the normal peritoneal relationships remain. Some of these bands may represent remnants of omentum which are supposed to regress from the cecum and ascending colon with development. He showed that they were present in 16 per cent of stillborn infants, equally distributed in the sexes, and in several instances there was definite kinking of the ascending colon even at this early age. Harvey felt that these bands were definitely congenital in origin and not due to inflammation. Mayo and others[5] later agreed with Harvey's concepts.

The attachments of these bands vary, but generally extend from the anterior tinea of the ascending colon upward and attach to the parietal peritoneum of the lateral abdominal wall.[6] Some are quite vascular, particularly in younger individuals. They easily strip off the bowel wall, except along their line of insertion. About 80 per cent extend for 1 to 2 inches along the transverse colon, and occasionally the terminal ileum is involved.

The cecum and colon proximal to the bands are dilated and the musculature of the walls markedly thickened. This is particularly true of older patients, and probably represents a true hypertrophy of the musculature from prolonged effort to advance the fecal stream past the partially blocked ascending colon.

This characteristic thick appearance of the cecum enables one to suspect the presence of these bands higher up on the ascending colon when the abdomen is opened through a McBurney or low midline incision.

Because of the failure of texts on anatomy and and surgery[9] to record this condition adequately, Bueermann[5] published an article dealing primarily with the basis of symptoms and establishing five axioms which had to be substantiated before a diagnosis of pericolic membrane syndrome could be made: (1) should have anatomical basis for symptoms; (2) symptoms should persist after removal of appendix; (3) if bands are released, symptoms should disappear; (4) should be found in all age groups if classed as a syndrome; and (5) if congenital, should be able to demonstrate a hereditary tendency. No case reports were presented with this article.

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 9–12, 1959.

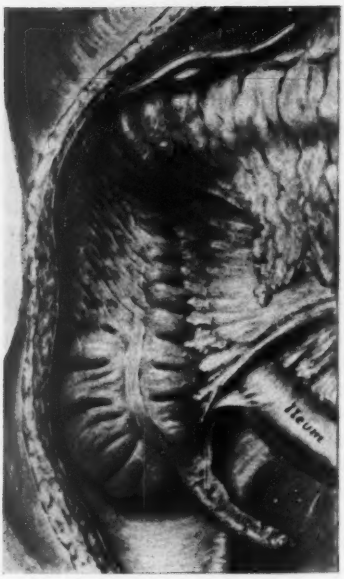

FIG. 1

SYMPTOMS

These patients usually complain of right-sided pain, varying in intensity and extending from the area of the cecum and ascending colon into the flank, which is more noticeable at the end of the day or when the patient is tired. It disappears soon after lying down. Frequently they complain of a mass in the right side that disappears when lying down; this represents a mass of fecal material and gas which slips past the constricted area of the ascending colon when the bands are relaxed by the recumbent position. The pain has no relation to meal time or diet, but is aggravated by running, jumping, traveling in rough riding vehicles, reaching up with the right arm, long hours of work or fatigue.

Many complain of not being able to sleep on their left side and of the pain being more pronounced during periods of constipation. Other digestive complaints, such as nausea, loss of appetite, lassitude and headache are frequent.

EXAMINATION

Tenderness and sometimes a mass are noted in the right lower quadrant, on examination. The dragging sensation and flank pain can generally be reproduced by having the patient lie on his left side with the right arm extended over the head, while making firm downward and inward pressure over the cecum. Frequently at operation, under a spinal anesthesia that is not too high, the pain can be reproduced by pulling the cecum down and tensing the bands attached to the posterior lateral peritoneum. X-ray is not of much benefit in confirming the diagnosis; only about 20 per cent show residual barium in the cecum after 8 hours. Thus we see that the diagnosis of this condition preoperatively depends almost entirely on the history and character of the pain plus the examination of the abdomen.

The only published case reports of any size on this condition *per se* are those of Bigelow.[1] In 1922 he reported 105 cases[2] of persistent pain following appendectomy with relief of symptoms in 93 per cent after the second operation with release of the pericolic bands. Bigelow thought these bands were inflammatory in nature because he was able to culture *Bacillus coli* from the serosa of the bowel after cutting the bands from the bowel wall. He published other case reports[3, 4] and, in 1950, he presented 101 cases with 96 per cent relief of pain.[1] The other two most common complaints, constipation and digestive disturbances, were relieved in 68 and 74 per cent, respectively. Of these, ¾ were women and ½ were of the thin, aesthetic type of individual.

In the past the emphasis has been placed on this syndrome *after* the appendix has been removed. I believe that with a careful history and physical examination the presence of these bands can be diagnosed preoperatively, and in many cases of so-called "chronic appendicitis" a second surgical procedure can be avoided.

In the past 10 years I have encountered these bands in 137 patients, of all ages. Most frequently, they occurred in the 20- to 30-year group, this probably being the period of greatest stress and activity (table 1). Of these, 7 had had previous appendectomy without relief of their symptoms; 17 were operated upon for acute appendicitis (diagnosed as such pathologically); 18 were found during the course of some other procedure unrelated to the colon or appendix; 3 were operated on for acute appendicitis (the bands were present but not released because of marked inflammatory reaction in the peritoneum). The remaining 100 were operated on because of long-standing pain, not relieved by medical treatment, and with a presumptive diagnosis of "pericolic membrane syndrome."

TABLE 1

	No. of Cases
Age (years)	
0–10	2
11–20	34
21–30	50
31–40	32
41–50	10
51–60	9
Sex	
Male	35
Female	102
Occupation	
Active	100
Inactive	37

TABLE 2

	No. of Cases	Relieved		Partial Relief		No Relief		No Follow-up
		M	F	M	F	M	F	
Previous appendectomy	7		7					
Pericolic band syndrome	100	24	55	1	7	1	1	11
Released in connection with some other operation	18		10					8
Acute appendicitis	17	3	6					
Bands not released	3		3					
Total	137							

OPERATIVE RESULTS

The operation consists in cutting the bands close to their attachment to the colon in order to relieve the torsion and constriction of that organ. A few small blood vessels may have to be ligated, particularly in the younger age group. The appendix is removed and any other bands around the cecum and terminal ileum are cut, that could kink or constrict the gut.

All patients with previous appendectomies were relieved of their major complaint of pain (table 2). Of the 100 operated on for so-called pericolic membrane syndrome: 79 were completely relieved of their pain; 8 were partially relieved; 2 obtained no relief at all; and 11 could not be followed. It is interesting that there was only 1 male in the no-relief category; he was a man of 35 who had a tremendously hypertrophied cecum, which I doubt will ever assume its normal size. Most of the partially relieved were women who complained of discomfort only before or during their menstrual period.

SUMMARY

1. Bands of the ascending colon commonly exist.

2. They are apparently congenital in nature.

3. They cause torsion and constriction of the ascending colon with consequent dilation and thickening of the cecum.

4. They do cause pain as demonstrated by the above mentioned downward pull on the cecum.

5. They are, I am sure, frequently responsible for right-sided pain in many individuals whom we are prone to label, and who may be, neurotics but still have a pathologic basis for their complaints.

6. They are easily recognized, and should be suspected when one is operating in the abdomen and finds a large, thick walled cecum.

7. They are easily disposed of by simply cutting them near their attachment to the colon and ligating a few bleeding points.

8. When these bands are found during the course of some other intraabdominal procedure, they should be cut unless contraindicated by the presence of infection or some other more serious consideration.

9. From all indications, even though they may be present from birth, they do not necessarily produce symptoms until the cecum becomes large and heavy enough in later life to put sufficient tension on them to produce pain.

10. In the selection of cases it would seem that particularly careful consideration should be given to women who associate their pain with the menstrual cycle.

11. Finally, if one is reasonably certain that persistent right-sided pain is due to these bands, and the symptoms are sufficiently severe to interfere with the patient's work and health, one is justified in operating for their release, whether the appendix has been removed previously or not.

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AIR CYSTS OF THE LUNG

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Air cysts of the lung, also called bullae, differ from true cysts in that they have no epithelial lining, and all have communications to bronchi or bronchioles. The pathology consists of emphysema which is generally thought to be due to severe bronchiospasm, or chronic infection of the bronchi or bronchioles, or a combination of both. During inspiration which is forceful, air fills the alveoli; because of chronic narrowing or spasm of the bronchiole, incomplete emptying occurs during expiration. This leaves air trapped in the alveoli, resulting in loss of elasticity of the alveolar walls, chronic distention, and the formation of air cysts. Air cysts may be single or multiple, localized to one segment of the lung, or involve all pulmonary tissue. A solitary cyst may be so large as to occupy an entire hemithorax.

The clinical picture of air cysts varies from no symptoms whatever to those causing extreme difficulty. Infections are rarely seen, and we personally have observed only 2 cases, 1 of which will be discussed later because of its many complications. Thus they differ much from true or epithelial lined pulmonary cysts which so frequently become infected.

We classify our air cyst patients into the following three classes: class I, patients showing only asymptomatic cysts, usually found on routine x-ray examinations; class II, patients with air cysts causing symptoms which can be relieved either completely or to a lesser degree by removal of the space occupying lesion; and class III, patients who cannot be helped by surgical therapy.

CLASS I

These are healthy, asymptomatic patients who are found on routine x-ray to have either large or small air cysts, usually localized to one pulmonary segment, and which may be single or multiple. Many such cases have been followed for years without complications. Figures 1 and 2 represent a man with no symptoms whatever, but whose cysts were removed surgically. Some cysts will rupture, causing spontaneous pneumothorax, and a rare one will develop air embolism following rupture into a blood vessel with fatal results. The latter complication is illustrated by the following brief case report.

Case 1. This is a 50-year-old healthy man who had had yearly physical examinations by an internist, always with normal findings, except for the bulla shown in figure 3. The week following his latest yearly examination he was stricken, while on a commercial flight in a nonpressurized plane, with unconsciousness, convulsions and shock. X-ray 1 hour after onset of illness is shown in figure 4, revealing hemopneumothorax and compression atelectasis of the left lung. He died 12 hours later. Autopsy showed rupture of the bulla into the pleural space and into a pulmonary vessel, with hemopneumothorax and an air cerebral embolus. Apparently, pressure changes caused the rupture.

Comments. This is a rare complication and it is usually fatal when it occurs. Probably all bullae should be removed although asymptomatic, in patients who will be flying in nonpressurized planes. We, in general, advise removal of all large cysts. Patients annoyed by repeated episodes of spontaneous pneumothorax due to air cysts also should have their cysts removed.

CLASS II

We shall illustrate this group of symptomatic patients who can be helped surgically with 2 case reports. In general, symptoms are dyspnea, due either to compression of normal lung tissue by large cysts, or to emphysema, or to both. The degree of emphysema affects adversely the results.

Case 2. This is a 45-year-old insurance executive with a complaint of dyspnea of 4 years' duration becoming progressively worse. He had to give up golf 3 years ago, and the shortness of breath had increased to the point that he could walk up no stairs, and even when simply walking he had to

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 1959.

FIG. 1. Large asymptomatic air cyst

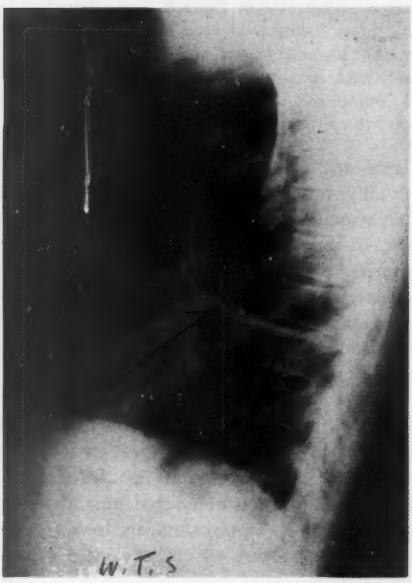

FIG. 2. Lateral view of figure 1. Note normal lung tissue anterior to cyst.

stop frequently to rest. X-ray revealed (fig. 5) large air cysts bilaterally with much compressed, adjacent pulmonary tissue. Physical examination and laboratory studies were normal except for absence of breath sounds on the left, poor sounds on the right, and a hemoglobin of 17 gm. Spirometric studies (table 1) were helpful, in that they demonstrated which side should first be operated upon, although we probably could have determined this by x-ray alone since there seemed to be more compression of normal pulmonary tissue on the left. A left thoracotomy revealed enormous air cysts which immediately bulged out through the incision under considerable pressure. All cysts were removed by local excision. Postoperatively, he developed substernal progressive type of discomfort which persisted at all times, and a pulse rate of 100 to 110 per minute, even at rest. The improvement in his dyspnea was not as much as expected. X-ray (fig. 6) showed a shift of the mediastinal contents to the left, or operated side, due apparently to the tension in the air cysts in the right, or unoperated side. We had not planned to explore the right side so early, but obviously it became mandatory; hence, 2 weeks after the first procedure the right side was operated upon. All cysts were removed on this side, also by local excision, and were almost as extensive as on the left. Convalescence was rapid after the second procedure, with return of the mediastinum to its normal position (fig. 7), a disappearance of substernal pain, and a normal pulse rate. A communique 5 months later stated that he was again playing golf and had minimal dyspnea.

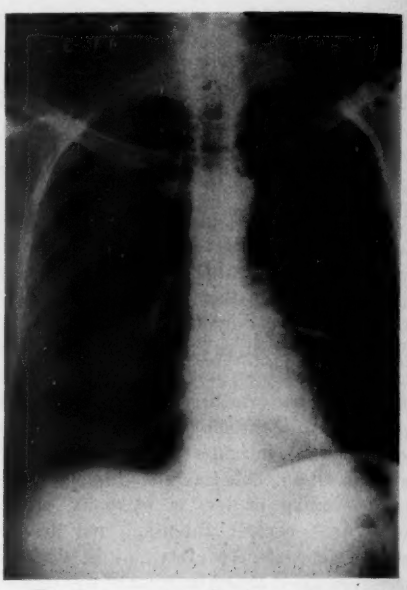

FIG. 3. Asymptomatic air cyst in case 1

FIG. 4. X-ray of case 1 after rupture

FIG. 5. Large bilateral air cysts, preoperative (case 2).

FIG. 6. Case 2, showing shift of mediastinum to left or operated side.

Comments. This case is the symptomatic patient who does well by removal of air cysts, since the basic emphysema is not severe, and there is sufficient compressed but unaltered pulmonary tissue to take over almost normal function after the large space occupying lesion are removed.

Case 3. A 46-year-old white man, a carpenter, was first operated upon by us in 1950 because of severe incapacitating dyspnea, due to emphysema

TABLE 1

Spirometric readings

	Normal	Patient (Case 2)
	per cent	*per cent*
Pulmonary ventilation		
Right lung...	55	76.4 (10.57 L./min.)
Left lung.....	45	23.6 (3.26 L./min.)
Vital capacity		
Right lung...	55	77.8 (2.65 L.)
Left lung.....	45	22.2 (0.76 L.)
Oxygen consumption		
Right lung...	55	89.9 (240 cc./min.)
Left lung.....	45	10.1 (27 cc./min.)

FIG. 7. Case 2, final postoperative x-ray showing return of mediastinum to midline.

and bilateral cysts. Bullae were excised on the right, or worse, side, and he returned to work as a carpenter in 2 months, being improved, although not without dyspnea, and refused surgery at that time on the left side. Six years later the incapacitating shortness of breath again became severe, in fact much more severe than ever before. He had dyspnea even at bedrest, and was always cyanotic. There was a compensatory rise in hemoglobin to 20 gm. A left thoracotomy was done at this time although he was considered a poor surgical risk.

FIG. 8. Multiple air cysts covering entire lung in case 3, showing bulging through operative wound.

His condition was shaky until the chest wall was opened, allowing the lung to protrude from the wound (fig. 8). After this his condition was satisfactory. After removing individual cysts for about 2 hours we obviously were making little or no progress because of the multiplicity of cysts; hence, with scissors we simply excised all cysts over the periphery of the entire lung surface, disregarding the bronchial communications, and leaving only fragments of visceral pleura. The result was mutliple points leaking air, both large and small, but normal appearing pulmonary tissue was observed everywhere. There were so many leaking points that the anesthetist had considerable difficulty expanding the lung with positive pressure. After closure he was connected to suction. The suction had to be discontinued *en route* to the recovery room and he developed extensive subcutaneous emphysema in this short period of time. However, when suction was again applied his condition became satisfactory and his convalescence was essentially normal. Six months later he had no cyanosis, a hemoglobin of 16 gm., and there was considerable improvement in dyspnea, although he cannot return to work as a carpenter.

Comments. This case represents a patient whose basic emphysema is severe, and he obviously will not be helped as much as the patient in case 2. This method of excision of air cysts is not an accepted procedure, and we hardly know whether to recommend it again. It should probably be used only in unusual cases, such as this. It is important to remove the parietal pleura to help the lung adhere to the chest wall, in all similar cases.

CLASS III

This group consists of patients who cannot be helped surgically because the air cysts are not

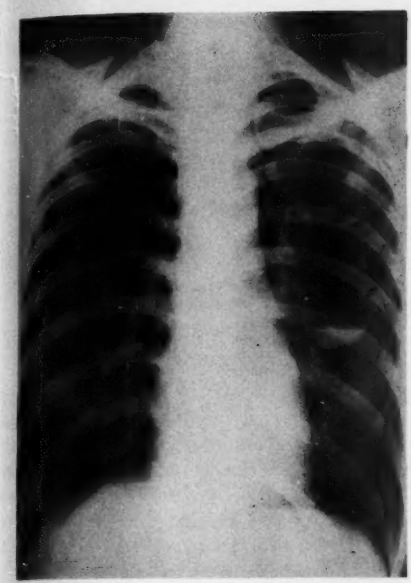

FIG. 9. Air cysts, one with fluid level in case 5

space consuming. This, too, will be illustrated by a case report.

Case 4. A 46-year-old white woman, who had been very athletic, began 5 years ago to develop repeated spontaneous pneumothorax on the left, and during these 5 years was hospitalized 10 times for collapse episodes. Three years ago dyspnea began and has rapidly progressed so that for the past 6 months she has been almost bedridden. Many attempts were made to make the pleural surfaces adhere by conservative methods, but all failed. A thoracotomy was done, only to prevent future collapse episodes, using 10 per cent silver nitrate streaked on the pleural surfaces. The surface of the lung was literally covered with small air cysts, lying just beneath the visceral pleura. They were about the size of the head of a match and were in no way space consuming.

Comments. Surgery at this time can do little to help this group. Basically, the emphysema is severe and there are no large space occupying cysts. Sympathectomy in general has been disappointing for such patients.

INFECTION

Infection is a quite rare complication of air cysts and we have seen only 2 cases, one of which underwent uneventful surgery. The other had so many complications that we think it worthwhile reporting as our final case.

Case 5. This is a 30-year-old white woman who had three episodes of spontaneous pneumothorax, and whose x-ray revealed air cysts, one of which contained a fluid level (fig. 9). She had a chronic productive cough with the sputum not resembling lung abscess material. There was minimal dyspnea. Left thoracotomy was done, removing all visible air cysts on the surface of the lung, and she made a normal recovery except the productive cough continued and she ran a low grade fever. Shortly after the patient left the hospital a routine x-ray again revealed the same cyst with the same fluid level which had been observed before surgery. We then thought she had a true epithelial lined cyst in the substance of the lung. Bronchogram, however, showed a bronchial communication, and an air cyst beneath the surface of the lung was demonstrated (figs. 10 and 11). Hence, she was reoperated upon 4 months later. An infected air cyst was found, just beneath the lung surface in the superior segment of the lower lobe adjacent to the fissure. A wedge resection, or local excision, was done. She then developed an empyema and bronchopleural fistula (fig. 12). Drainage of the empyema was done, and 6 weeks later a decortication was performed, also removing the parietal pleura and closing the fistula. At completion of the

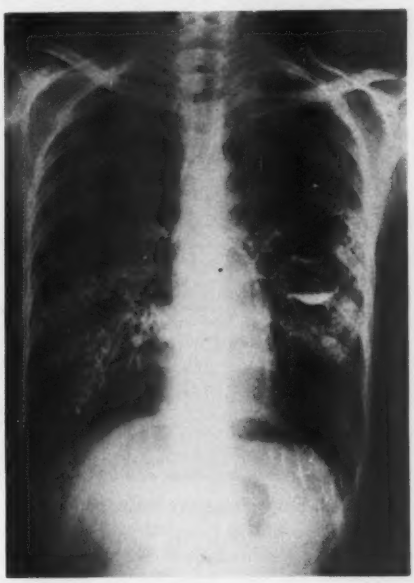

FIG. 10. Bronchiogram of case 5; anteroposterior view after first operation.

FIG. 11. Lateral view of figure 10 (case 5)

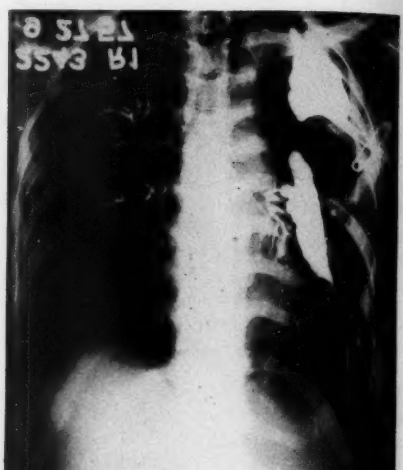

FIG. 13. Localized empyema and bronchopleural fistula (case 5).

FIG. 12. Empyema after drainage (case 5)

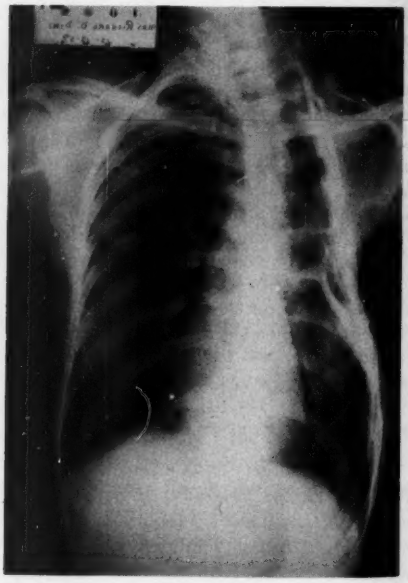

FIG. 14. Postoperative thoracoplasty (case 5)

decortication the lung expanded nicely and filled completely the left hemithorax. Suction was applied and we thought her problem was solved. She again, however, developed recurrence of the bronchopleural fistula with localized empyema (fig. 13), and she later had to have a thoracoplasty (fig. 14). Since the latter procedure she has been well, but she has permanent loss of much good

pulmonary tissue due to the thoracoplasty, which is an undesired result in such cases.

Comments. This patient developed so many complications that we now do not recommend local excision or wedge removal of infected air cysts. Instead, a segmental removal of a lobe seems much safer since the bronchus can be adequately closed. Our 2nd and only other case of infected bullae was treated by segmental removal. Convalescence was uncomplicated, and we plan to do this always in the future.

TREATMENT

In addition to the methods of treatment previously described, *i.e.*, simple excision of cysts and segmental or lobar resection, other procedures which have been employed are needle aspiration, tube drainage, and exteriorization of cysts. Certainly, simple excision seems the method of choice. It must be remembered that these patients are usually emphysematous to some degree, and will need in the future all functioning pulmonary tissue. For this reason one should not sacrifice any normal or near normal tissue, such as would be done with a segmental resection. This point cannot be emphasized too strongly. Even though the pulmonary tissue adjacent to a removed air cyst does not appear completely normal, it should be left in and will usually expand satisfactorily.

We believe needle aspiration is rarely indicated, and is potentially a dangerous procedure. Tube drainage is indicated only in ill patients unable to undergo surgery, and can be quite useful at times. It must be remembered, however, that once the chest wall is opened, allowing the lung or cysts to protrude through the wound, the condition of the patient who was shaky before surgery immediately improves. Because of this we have not used tube drainage, instead resorting to more definitive surgery.

Most patients can be helped by removing space occupying cysts. Even though the basic emphysema is severe, some relief is obtained when such lesions are excised. Many patients who are almost completely incapacitated can be restored to at least a comfortable existence when space occupying masses are removed, by allowing adjacent compressed pulmonary tissue to expand and be useful again.

SUMMARY

Pulmonary air cysts have been classified, and cases illustrating each class have been reported. Infected cysts are rare and should not be treated by local or wedge removal because of the possible development of bronchopleural fistula and empyema. Instead, a segmental resection is preferred. In all other instances the procedure of choice is local excision of cysts with emphasis being placed on preserving as much pulmonary tissue as possible. A rare case of fatal air embolism following rupture of a cyst during air travel in a nonpressurized plane is reported.

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SPONTANEOUS RUPTURE OF THE ESOPHAGUS COMPLICATING MAJOR ABDOMINAL SURGERY

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One of the rarest of all complications of major abdominal surgery is "spontaneous rupture of the esophagus." A careful survey of the English medical literature disclosed no such case reports although the possibility has been mentioned.[4]

The following case studies are reported because (1) the nature of the complication was not recognized until autopsy; and (2) it is hoped that by bringing the condition to the attention of the surgeon, he will be aware of and recognize a complication that can be successfully managed.

CASE REPORTS

Case 1. L. V. (480042), a white woman aged 45 years, was admitted to Garfield Memorial Hospital on January 9, 1948. She had complained of attacks of epigastric pain of 5 years' duration which radiated aroung the right costal margin to the right shoulder blade. These attacks were associated with nausea, vomiting and gaseous distension of the abdomen. She had sustained severe postpoliomyelitis deformities of the legs, hips, spine and shoulders. The principal physical findings were an epigastric mass and tenderness over the gall bladder area. A preoperative diagnosis of cholelithiasis and pancreatic cyst was confirmed by radiographic study.

On January 13, 1948, a cholecystectomy and subtotal resection of the body and tail of the pancreas, from which arose a 15-cm. cystadenoma, was accomplished. The first 2 postoperative days were uneventful. The patient received intravenous fluids and nasogastric suction and maintained a blood pressure of 130/80 mm. mercury. The temperature rose to 100° and the pulse to 110 per minute. The 3rd postoperative day was uneventful except that the patient developed an oliguria with only 400 cc. output for the 24-hour period. An enema was productive of flatus and a small stool. The nasogastric suction was discontinued and the tube removed. On the 4th postoperative day the patient developed gastric dilation, requiring reinsertion of the nasogastric tube, and 1500 cc. of greenish black aspirate were obtained with relief of the distension. After the introduction of an intravenous cannula and the administration of 4000 cc. of fluids with required electrolytes, the urinary output increased to 1500 cc. for the 24-hour period. The blood pressure remained stable at 130/90, temperature at 100°, and the pulse dropped to 90 per minute. The abdomen was flat and soft, and peristaltic activity was normal.

At 6:00 a.m. on the 5th postoperative day the patient suddenly pulled out her Levin tube and vomited. She immediately went into shock, became cyanotic, had a barely perceptible pulse and blood pressure was unobtainable. By 12:00 noon her temperature was 102°. Blood, intravenous fluids, oxygen and pressor agents did not relieve her state of shock. The lungs were clear except for a few basal rales posteriorly and an immediate portable roentgen study of the lungs disclosed no abnormality. The electrocardiogram was interpreted as showing only a sinus tachycardia. A medical consultant was of the opinion that a pulmonary embolus was probably responsible for the clinical picture despite no abnormal findings in the lower extremities. The patient became progressively worse, went into coma during the evening and died early in the morning of the 6th postoperative day.

Autopsy permission was obtained. The principal findings were a 5-cm. linear rupture of the esophagus just proximal to the esophagogastric junction, allowing free discharge of gastric contents into the left pleural space which contained about 1000 cc. of greenish black gastric material. There was an incidental 4-cm. esophageal hiatus hernia. Microscopic studies disclosed no evidence of ulceration of the esophagus and confirmed the presence of acute mediastinitis and acute pleuritis on the left. There was no evidence of myocardial or pulmonary infarction.

Case 2. J. T. K. (01-62-32), a 74-year-old white man, was admitted to the Washington Hospital Center July 6, 1958, for the removal of polypoid tumors in the midascending and left colon. He had undergone a left hemicolectomy for a perforating carcinoma involving the distal splenic flexure of the colon 2 years before admission. He had recovered rapidly and regained 35 pounds. Routine annual follow-up barium enema roentgen study had disclosed the presence of polyps, which

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 9 to 12, 1959.

was confirmed by repeating the study. The examination of the upper gastrointestinal tract showed an ulcer in a gastrojejunostomy performed in 1928 for an obstructing duodenal ulcer.

The patient was a healthy appearing, alert, well developed, elderly man in no distress; blood pressure, 140/90; pulse, 70; temperature, 98.6°. No gross physical abnormalities were present except for a small incisional hernia at the site of an upper right rectus scar. Sigmoidoscopic examination disclosed no abnormality. The blood count, urinalysis, blood urea nitrogen, albumin-globulin ratio and fasting blood sugar were normal. The electrocardiogram was reported as showing no abnormality.

After preparation with purgation, Neomycin-Mycostatin and enemas, the patient was operated upon July 10, 1958. Multiple colotomies for removal of adenomatous polyps, coloscopy and revision of the gastrojejunostomy were performed uneventfully. The immediate postoperative reaction was satisfactory and he was maintained with intravenous fluids and nasogastric suction.

At 4:00 p.m. on the 1st postoperative day, approximately 36 hours after surgery, the patient became nauseated and vomited, although the Levin tube was in place and functioning well. Three hours later he suddenly became cold, clammy and apprehensive and went into shock with a blood pressure of 60/0 and a rapid, barely perceptible pulse. The only pain complained of was incisional in origin. To use of blood, intravenous fluids and pressor agents he responded well except for oliguria (200 cc. output). He continued to sweat profusely, although his blood pressure was 120/70. The temperature was normal. He passed flatus per rectum during the night. The 2nd postoperative day his blood pressure varied from 60/0 to 100/70. He passed rectal flatus freely; the lung fields were clear. An electrocardiogram showed no change from the preoperative tracing. Blood chemistries were within normal limits. The nasogastric tube was removed and small amounts of clear liquid were allowed by mouth. The patient continued to be cold, clammy and apprehensive. He took liquids eagerly but eructated considerably despite admonitions to the contrary. At 11:00 p.m. he vomited and refused anything further by mouth. His blood pressure was 110/70; pulse, 100; temperature, 99°; and he had no complaints of pain.

On the 3rd postoperative day he continued to refuse anything by mouth and support was continued with intravenous fluids and proper electrolytes. Oliguria continued. One examiner heard a pericardial friction rub but this could not be confirmed by others. The lungs remained clear, the abdomen was soft and peristalsis was active. During the evening he regurgitated a mouthful of bile stained material occasionally when he eructated.

On the 4th postoperative day the blood pressure was 110/70 and the pulse 116. Coarse rales and rhonchi were heard over the chest and the patient was coughing greenish sputum. The electrocardiogram showed auricular premature contractions and evidence of myocardial impairment. Roentgen film of the chest disclosed the diaphragm to be slightly elevated and a shadow behind the cardiac silhouette was interpreted as a possible pulmonary infarction. He had a spontaneous normal bowel movement and still refused anything by mouth. The blood urea nitrogen was 20 mg. per cent and oliguria continued. An indwelling polyethylene catheter was placed in the right femoral vein for further intravenous support. At 10:00 p.m. he vomited, following which he became extremely restless, cyanotic, cold and clammy, with blood pressure 90/60, pulse 140. Morphine sulfate, gr. 1/6, was given to control general discomfort and restlessness.

On the 5th postoperative day, the blood pressure varied from 90/60 to 0/0. Dyspnea, tachypnea and cyanosis were helped very little by either oxygen tent or intranasal oxygen. The temperature rose for the first time to 100.8°. He was confused, restless, cyanotic and sweating profusely. Hydrocortisone and cortisone acetate had no effect on stabilizing his shock or otherwise improving his condition. During the following day the temperature rose to 103° and he became comatose and died.

Postmortem examination disclosed a 2-cm. linear rupture of the esophagus just above the cardia of the stomach involving the right lateral wall of the esophagus, resulting in an acute mediastinitis and a small right basal hydrothorax containing 300 cc. of greenish black, sour smelling gastric contents. There was no evidence of pulmonary or coronary infarction. Pulmonary edema and patchy bronchopneumonia were present. Microscopic study confirmed the gross findings and disclosed no evidence of esophageal ulceration.

DISCUSSION

Boerhaave reported the first case of spontaneous rupture of the esophagus in 1724.[3] In 1946 Barrett[2] reported the first case successfully treated by operation. Fewer than 200 case reports have been recorded since that time, none of them as a complication of surgery.

Characteristically, spontaneous esophageal rupture occurs after vomiting in a middle-aged or elderly person who has overindulged in food or

drink. This is followed by severe, agonizing pain beneath the sternum, in the chest and upper abdomen and may radiate to the back, shoulder or neck. A shocklike picture of pallor, sweating, apprehension and dyspnea associated with a normal or slightly elevated blood pressure and rapid pulse of good quality is present. Cyanosis and subcutaneous emphysema in the neck may be present and, if so, should suggest the diagnosis immediately. Fever due to mediastinitis is present within a few hours. The abdomen may be rigid but is nontender. A crackling sound may be heard over the precordium. Radiographic films may confirm the presence of varying degrees of pneumothorax or hydropneumothorax, widening of the mediastinal shadow or merely a blunting of the costophrenic angles. Unfortunately, none of these roentgen findings were present in the cases herein reported. Fluid obtained by thoracentesis should suggest gastric contents and if methylene blue is given orally, it will appear in the pleural fluid aspirated. Esophagrams, using Lipiodol or thin barium paste, will disclose the presence and level of the perforation which is usually 1 to 3 cm. proximal to the esophagogastric junction. Either side of the lower esophagus may be ruptured but the left wall is much more frequently involved.

The mechanism by which vomiting produces esophageal rupture has been studied by several investigators.[1,3-5]

The present consensus supports the sudden change in intraluminal pressure caused by violent contraction of the stomach creating a retrograde jet of high hydrodynamic force into the esophagus.[5] In the lowermost region of the esophagus is an anatomically weak point where major vessels and nerves enter the organ and where it has little external support. Here, the muscular coats are poorly defined and the spiral layers may be absent. Angulation of the organ occurs at the diaphragm. It is in this anatomically weakened area that the characteristic vertical linear tear in the esophagus is found.

The management of vomiting and its causes is a matter for daily concern to the abdominal surgeon. It is indeed surprising, then, that such a complication as reported in this communication has not been reported before. One cannot but wonder how many of the patients who have died from "a heart attack" after vomiting postoperatively (and did not have a postmortem examination) may not in fact have had a perforated esophagus. Likewise, this may be true of non-autopsied patients dying of "pancreatitis," "pneumonia" and perhaps other sincere but erroneous diagnoses. It is a humbling experience to be confronted by a totally unexpected pathologic finding in the autopsy room. Nevertheless, progress depends on our essential curiosity and searching for the truth which can be satisfied only by postmortem examination.

The cases of esophageal rupture presented in this report were different in the physical reaction to the catastrophe as compared to the usual syndrome as it occurs in otherwise healthy people. Neither complained of the usual pain. Both patients went into shock of an extreme type which was most difficult to manage. Both patients had Levin tubes and nasogastric suction which must certainly be considered in the etiology whether or not they were actual factors. Both situations followed major, somewhat complicated, surgical procedures which undoubtedly placed extreme demands on the patients' physiology, and the possibility of stress ulceration must be considered. The refusal of the patient to take anything by mouth, cyanosis, sweating, apprehension, shock and fever were the common findings in both patients. The absence of changes in the electrocardiogram and chest radiogram is most important.

On the basis of the experience herein recorded, it is recommended that, for postoperative patients who go into collapse following an episode of vomiting and whose physical findings, electrocardiogram and roentgen film on the chest show no pathology, one should suspect rupture of the esophagus and obtain an esophagram.

On confirmation, the ruptured organ should be repaired by transthoracic approach, the mediastinum opened widely and the pleural space drained.

SUMMARY

A rare complication of major abdominal surgery is spontaneous perforation of the esophagus. If unrecognized, the condition is fatal. Two such case reports are recorded which were discovered by autopsy.

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MASSIVE POSTOPERATIVE HEMATEMESIS FOLLOWING SUBTOTAL GASTRECTOMY*

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The endeavor of every responsible surgeon is to carry his patient through a surgical procedure with the least possible disturbance of normal physiologic processes and without complications.

Immediate, massive postgastrectomy hematemesis is a rare but dreaded complication. It is mentioned but little because of its implication of the indictment of the surgical ability of the surgeon.

Blood may usually be aspirated from the gastric pouch immediately following subtotal gastrectomy. It is usually of minor quantity, quite temporary and of no consequence. In rare instances the bleeding is of considerable magnitude, sufficiently progressive and exsanguinating to require operative intervention.

Early bleeding may originate from one of the suture lines of the gastrointestinal anastomosis. Treatment usually consists of gastric tube suction with frequent irrigations. Intragastric thrombin and various topical hemostatic agents have been used. However, when the blood pressure continues to drop and active massive bleeding persists, surgical exploration is indicated.

As stated above, a certain amount of postoperative bleeding may be expected in all cases after subtotal gastrectomy; however, when massive hematemesis develops, conditions other than bleeding from the anastomosis must be considered. A careful perusal of the patient's past history, and attention to significant signs, symptoms or conditions found at operation will usually prove most helpful.

The author's interest in the problem was stimulated by 2 patients who developed massive postoperative hematemesis. They were both suspected of bleeding from the line of anastomosis but were proved to have bled from esophageal veins, one from varices secondary to cirrhosis of the liver and the other secondary to a severe esophagitis.

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CASE REPORTS

Case 1. A. M. (No. C94471), a 37-year-old white man, was admitted to St. Vincent's Hospital, New York City, on December 7, 1953, for elective surgery; *i.e.*, gastric resection for peptic ulcer. He had had a history of recurrent episodes of epigastric distress with vomiting for a period of 3 years. Gastrointestinal x-rays taken on several occasions revealed the presence of an active duodenal ulcer and the last series taken just before admission revealed the presence of some pyloric obstruction.

The patient had been put on a strict medical regimen for several years but did not respond satisfactorily. The most significant point in the past history was that he did partake of alcoholic beverages to excess.

While in the hospital, laboratory findings before operation were essentially negative. The blood picture, blood pressure and liver function tests were within normal limits. Vascular spiders (nevus araneus) were noted on the forehead and the superior part of the anterior chest wall. The remaining physical examination was normal.

On December 11th a high gastric resection was performed, removing approximately 75 per cent of the stomach, and an antecolic short loop type of gastrojejunostomy was done. A two layer anastomosis was performed with ligation of all bleeding points. A Levin tube had been inserted into the stomach before operation and lavage at the end of the anastomotic procedure revealed that there was no bleeding at that time.

At operation the liver appeared to be smaller than normal. There was one very large vein in the region of the gastrocolic omentum which appeared rather abnormal and had to be ligated. In the light of what transpired later this was a significant finding.

The postoperative course (first 24 hours) was uneventful except that the patient was quite uncontrollable when he was coming out of the anesthesia. Drainage from the Levin tube was serosanguineous but not excessive.

On the morning after the operation a massive hematemesis occurred in spite of the presence of the Levin tube. The blood pressure was 130/70 and vital signs were stabile. The amount of blood was about 500 cc. and it was dark and semi-

coagulated. Drainage from the Levin tube continued to be serosanguineous. At 3:30 p.m. another massive hemorrhage occurred (500 cc.). The stomach was then lavaged and thrombin injected through the Levin tube. Another 600 cc. of blood was vomited at 9 p.m. The blood was not bright red. At this time the pulse became elevated and the pressure was 90/50. Blood replacement had been instituted throughout the day; however, exploratory laparotomy was considered mandatory and was done at 10 p.m.

At laparotomy there was no free blood in the peritoneal cavity and very little blood in the upper jejunum. The anterior part of the anastomosis was taken down and one small bleeding vein was found on the anterior aspect of the anastomosis. This did not appear particularly guilty of the massive hemorrhage. Further exploration of the gastric pouch revealed the presence of large massive clots in the cardiac end of the stomach and, upon removing them, a blood cast of what appeared to come from the lower esophagus was removed. A hot gauze pack was placed in the cardiac end of the stomach and pressure applied up toward the esophagus. After this was removed no more bleeding could be seen. The anastomosis was re-established and the abdomen closed. The Levin tube was not replaced. The patient's course was then uneventful and he was discharged on the 12th postoperative day.

Case 2. D. R. (No. 091324), a 58-year-old white man, was admitted to St. Vincent's Hospital, New York City, on January 9, 1959, with vomiting of 7 days' duration. He had had a history of recurrent episodes of gastric distress with vomiting for a period of 5 years. Gastrointestinal x-rays taken on several occasions revealed the presence of a gastric ulcer. X-rays shortly after admission to the hospital revealed a marked gastric outlet obstruction with the presence of a large ulcer on the lesser curvature of the stomach. While he was being prepared for surgery, the patient continually complained of a severe substernal burning sensation. He had been receiving gastric lavages twice daily; however, this did not relieve him of the condition and approximately 7 days after admission he had a hematemesis of about 500 cc. of blood. Transfusions were administered, and his condition became stabile. The substernal burning sensation became progressively worse until the time of operation.

On January 19, 1959, a laparotomy was performed and a large indurated mass was found extending along the lesser curvature and upward towards the esophagogastric junction. The body of the pancreas was involved. A high subtotal gastric resection with a segmental resection of the involved portion of pancreas was performed, and a two layer anticolic type of Polyá anastomosis done to re-establish continuity of the alimentary tract. A Levin tube had been placed into the stomach before operation, and lavage of the gastric remnant at the termination of the anastomotic procedure revealed that there was no bleeding at that time.

One hour after the patient left the operating room, while in the recovery room, with the Levin tube still in place, he had a massive hematemesis of about 500 cc. of dark red blood. The Levin tube continued to drain what appeared to be fresh blood and within the next hour the patient had had two more episodes of hematemesis with the loss of at least another 1000 cc. of blood. Four units of blood were given and the patient was re-explored immediately.

At operation there was no free blood in the peritoneal cavity and very little blood in the upper jejunum. The gastric remnant was markedly distended with a clotted mass of blood. A gastrostomy was performed above the anastomosis and the large clot evacuated. Further exploration of the gastric remnant revealed the presence of several more large clots coming down from the region of the lower esophagus. These were removed and then the anastomotic area could be clearly visualized. Two small areas of venous ooze could be seen along the anastomosis but these could not have been responsible for the massive hematemesis. Some blood could be seen coming down from the region of the esophagus. The upper end of the stomach remnant was packed for several minutes and then, when no further bleeding occurred, the gastrostomy and anterior layer of the anastomosis were repaired and the abdomen closed.

There was some slight bleeding for the next 48 hours from the Levin tube which had been left in place; however, the tube was removed after 48 hours and all bleeding ceased. He was given another unit of blood on the 3rd postoperative day and was discharged on the 14th day after operation.

COMMENT

The amount of bleeding that usually occurs following subtotal gastrectomy is most often minimal and subsides within 24 to 48 hours after operation. When immediate postoperative massive hematemesis occurs, one should suspect conditions other than bleeding from the anastomotic area.[2]

The history of excessive alcoholic intake was significant in case 1, in spite of the presence of what appeared to be a normal liver at operation and of a normal liver profile in the preoperative

investigation. The existence of vascular spiders was also helpful, since according to Brick and Palmer[1] the findings of vascular spiders should suggest not only cirrhosis but also esophageal varices. The presence of the very large vein in the gastrocolic omentum indicated some degree of venous obstruction and possibly portal hypertension. Application of the Levin tube before operation and its pressure against friable esophageal veins may well have been one of the contributing factors in causing massive hemorrhage. The negative postoperative x-ray findings of varices of the esophagus was disappointing; however, varices can exist without positive x-ray evidence and it is also known that the presence of the pressure in such varices is variable.

The prolonged history of vomiting secondary to pyloric obstruction was significant in case 2. His history and the complaint of a persistent substernal burning sensation were indicative of a severe degree of esophagitis. The hematemesis that occurred shortly after admission to the hospital following a week of daily passage of the Levin tube was most likely the result of bleeding from the esophagus. The massive bleeding immediately following the gastrectomy and the findings at the time of the re-exploration indicate that the probable site of bleeding was from friable esophageal veins made vulnerable by the pre-existing esophagitis and the daily passage of the Levin tube down the esophagus into the stomach.

SUMMARY

1. Two patients with immediate postoperative hematemesis are reported.

2. Cause of hemorrhage was due to ruptured esophageal veins in both patients, with portal hypertension in one and acute esophagitis in the other.

3. Emergency exploratory operation with removal of the clot appeared to be the procedure that checked the progress of the hemorrhages. The removal of the clot caused retraction of the offending vessel with cessation of the bleeding.

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EXPERIENCE AND THE USE OF THE ZIMMERMAN TYPE OF HERNIOPLASTY: A NEW CONCEPT OF THE TRANSVERSALIS FASCIA

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Following the use of the standard hernia repairs for inguinal hernia for a period of some 14 years, it was determined by a survey that all of these repairs were inadequate in our hands for the proper correction of the hernia defect.

The problems encountered were a recurrence rate which ranged in the neighborhood of 8 per cent, and interference with the blood supply to the testis with postoperative swelling and late atrophy which was a minor but troublesome problem.

The techniques which had been used were those of Ferguson, Basinni, and Halsted[1] with various modifications. The Cooper's ligament repair of McVay and Anson[2] was used, but was also found lacking for the same reasons. In October 1954 the method of Zimmerman[3-5] was adopted. This procedure was carefully followed during the ensuing 4 years, on 200 consecutive inguinal hernias.

TECHNIQUE

The usual inguinal hernia incision is made through the skin and the external oblique fascia is carefully cleaned and bared for a considerable distance. The rolled edge of the inguinal ligament is carefully cleaned during this dissection. The ilioinguinal and the iliohypogastric nerves are noted and preserved. An incision is then carried through the aponeurosis of the external oblique to map out a lateral flap of aponeurosis. This is accomplished by dividing the external inguinal ring at the junction of its medial one-third and its lateral two-thirds and carrying the incision obliquely outward toward the inguinal ligament in the region of the abdominal inguinal ring. The flaps are carefully elevated and the inguinal ligament is carefully cleaned from above the abdominal inguinal ring to the pubic tubercle. The undersurface of the medial flap of aponeurosis is carefully cleaned.

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, March 9 to 12, 1959.

At this point the spermatic cord is elevated from its bed and the floor in the inguinal canal is carefully cleaned (fig. 1). The conjoined tendon is delineated but is not disturbed in any way. The transversalis fascia is identified but is cleaned more carefully later in the operation (figs. 1 to 3).

An evaluation is then begun by carefully checking the floor of the inguinal canal for any defects. This is extremely important because failure to recognize direct hernia defects probably accounts for as many of the so-called recurrent hernias as any other one factor. There is one particular place that should be given close attention at this point and that is the junction between the transversalis fascia and the rectus sheath. It is in this very small area that protrusions of properitoneal fat may occur and may produce herniations of the fat, causing a recurrence at a later date. Two of our recurrences represent exactly this situation. They were so small in fact that they could be repaired by a single mattress suture of No. 00 chromatic catgut.

When it has been determined whether there is a direct hernia, the cord itself is stripped of its coverings by removing the cremasteric and internal spermatic fascia from above downward. This can be done by blunt dissection medially, laterally and anteriorly. Posteriorly, the blunt dissection will cause considerable bleeding from vessels which are branches of the inferior epigastric artery and vein, and it is necessary to clamp this area and divide it between clamps with ligatures of No. 00 chromic catgut being applied (fig. 1). When the coverings have been entirely removed, any excess fat in the form of lipomas is removed from the cord. This diminishes the cord in size and is extremely important in the careful repair of the abdominal inguinal ring which must be made as small as possible.

An indirect sac is then searched for on the anteromedial portion of the cord, and the sac is dissected high and suture ligated with No. 1 chromic catgut and allowed to retract after excision of the redundant distal portion.

FIG. 1. Cord stripped anteriorly, medially and laterally. Posterior cord coverings and vessels clamped and cut; sac ligated.

FIG. 2. Transversalis fascia shown as a continuous separate fascia.

FIG. 3. Transversalis fascia shown as continuation of ensheathing fascia of transversus abdominis muscle.

When this has been completed the cord is quite small and can be dealt with easily with a very satisfactory repair of the abdominal inguinal ring. The shelving border of the internal oblique and the conjoined tendon are then elevated with a retractor and careful dissection is carried out to identify and clean the transversalis fascia. It is very important to identify the fascia itself and this is frequently one of the confusing points in the operation.

It is important to bear in mind the possibility of two anatomical situations with relation to the transversalis fascia. This has been established to our satisfaction in the anatomical laboratory.

Anatomically, an entirely separate sheet of tranversalis fascia may be interposed as a very excellent layer between the peritoneum and the transversus abdominus muscle. In this case there will be no muscle fibers to be dealt with in the repair of the hernia (figs. 1 and 2).

However, a second situation may prevail in that the transversalis fascia is represented only as an extension of the ensheathing fascia of the transversalis muscle which is carried medial, to be inserted into the pubic tubercle and the inguinal ligament. In this situation muscle fibers will be encountered in the lateral portion of the repair. This is the more frequent anatomical situation (fig. 3).

It is important to identify whichever anatomical variation is present and to use the best fascia obtainable. When this has been determined, the fascia is carefully sutured to the inguinal ligament around the stripped down spermatic cord. It is sutured quite snugly so that a Kelly clamp alone can be introduced into the internal or abdominal inguinal ring. This snug closure can be accomplished without damaging the blood supply to the testis because the structures are elastic and do allow some distension. This is not the case in some of the routine hernia repairs where the structures are quite inelastic and necessarily demand almost boardlike suturing to hold satisfactorily. It may be occasionally necessary to add an additional suture superior to the cord to properly fix the internal ring. This is not common but may be necessary when a triangular defect results after suturing the transversalis fascia to the inguinal ligament.

Although in the original descriptions of this operation it was decided that this alone was sufficient repair for the indirect hernia, it has been our practice as more experience has been gained to carry the repair of the transversalis fascia down the entire length of the inguinal ligament in the inguinal canal to the pubic tubercle, paying very careful attention to the area in the region of the pubic tubercle and along the edge of the rectus sheath.

If an indirect hernia is the only problem which

is presented, this is sufficient with replacement of the cord and suture of the cut edges of the aponeurosis of the external oblique with interrupted sutures of No. 0 chromic catgut.

In the direct hernia, after the repair of the transversalis fascia has been completed with the consequent inversion of the sac, the lateral flap, which had been demarcated as a triangular flap, is laid directly upon the newly created bed of the transversalis fascia. This is carefully sutured at its edges in the form of a blow-out patch to further strengthen and buttress the area of Hesselbach's triangle. At the conclusion of this the cord is laid on the newly created bed, and the medial flap of aponeurosis is dissected free from the underlying muscle and the overlying subcutaneous tissue and sutured to the outer edge of the inguinal ligament with interrupted sutures of No. 0 chromic catgut. In general the skin is closed with clips in the adult patient and subcuticular sutures in the infant.

MATERIAL

There were 200 consecutive hernia repairs on 157 patients (table 1). All women, and children under the age of 3 were excluded. This was felt necessary because a complete obliteration of the canal is done in women routinely, and in the very young the operation is less extensive because of the fear of damaging the blood supply to the testis. All of the repairs were primary. No recurrent hernias are included.

The age range was from 3 to 89 years with an average of 38.3 years.

There were 155 indirect hernias, 16 direct hernias and 29 combined direct-indirect hernias.

RESULTS

Postoperative difficulty has been singularly absent in these hernia repairs. There has been little or no testicular swelling and there has been no testicular atrophy. Postoperatively, the patients are allowed to be ambulatory from the 1st day onward. They are usually discharged from the hospital on their 5th day and are allowed to return to light activities after 3 weeks. They are restrained from active heavy work for 6 weeks, since we feel that muscle tone has not returned for a period of about 6 weeks even though fascial healing has been perfectly satisfactory after the usual 3- to 4-week period.

The recurrence rate was 2.5 per cent, and has occurred primarily in the direct areas. Two of these were subsequently repaired by individual mattress type suturing, using No. 00 chromic catgut. They have not recurred. Two others appeared to be a complete breakdown in the direct area and may well have been an area of weakness which should have been buttressed by the lateral flap of the aponeurosis of the external oblique. A suture failure is more probable. One patient has deferred reoperation and therefore an analysis of this recurrence cannot be made.

TABLE 1

No. of Patients	157
No. of Hernias	200
Age of patient	
Youngest	3
Oldest	89
Average	38.3
Type of hernia	
Indirect	155
Direct	16
Combined	29
Recurrences	
Number	5
Percentage	2.5

It is noteworthy that some of the more severe hernias, particularly those of a combined type which have been done by the direct technique, have not recurred whereas the others which should have been simpler hernias and should have been more stable as far as recurrences are concerned have been involved in the recurrent hernias which have been detected.

It is admitted that this is a small series carried over a relatively short period of time. However, in comparison with other repairs in the hands of the authors there is a very marked diminution in the number of recurrences. It is the opinion of the authors that this is a more anatomical approach to the repair of hernias. The repair which is accomplished does nothing to destroy the fundamental anatomical relationship of the inguinal canal in coming through the abdominal wall in an oblique fashion. It is well known that the obliquity of entrance or exit in the body is one of the primary mechanisms for prevention of difficulties of this type, as witness the entrance of the fallopian tube into the uterus, the ureter into the bladder and the abdominal inguinal ring itself. There is, also, no

destruction of the shutter mechanism, which is a dynamic mechanism under muscle and fascial control.

The repair of recurrent hernias is much easier than one finds when having to repair a recurrent hernia which has been subjected to other techniques. In 2 instances the repair was easily accomplished by a single suture in the transversalis fascia in the region of the rectus sheath.

SUMMARY

A method of hernioplasty essentially that of Zimmerman is described. This method of hernioplasty has been used for the past four years on 200 consecutive inguinal hernias. It is the feeling of the authors that this hernioplasty offers a fundamentally sound anatomical approach to the problem of inguinal hernia and with a careful, meticulous effort satisfactory hernia repair can be obtained with a minimum of recurrence and complication.

An evaluation of the concept of two anatomical variations of the transversalis fascia is presented.

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PANCREATIC FUNCTION STUDIES IN CHRONIC BILIARY DISEASE*

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INTRODUCTION

The frequent association of chronic biliary disease and pancreatic disease is well known. The common channel theory in which the common bile duct and main pancreatic duct unite to form a single opening into the duodenum has been given much attention. In this anatomical circumstance a gallstone impacted in the ampulla or even spasm of the sphincter of Oddi causes obstruction at the ampulla with reflux of bile into the pancreatic duct, resulting in activation of trypsinogen and pancreatitis. In cases where actual infection of the gall bladder exists, there is a possibility of bacterial spread to the pancreas. A history of alcoholism or a history of excessive indulgence in alcohol immediately before an attack of pancreatitis is frequently obtained. In addition, ischemia of the pancreas from any cause that interferes with its blood supply has been suggested as a factor in the etiology of pancreatitis.

In chronic relapsing pancreatitis the repeated insults to the pancreas frequently result in progressive destruction of acinar tissue with fibrosis of the pancreas and calcifications. In late stages pancreatic insufficiency is often manifest. Because of the pancreatic insufficiency, weight loss, steatorrhea, and loss of nitrogenous substances in the feces occurs. In addition, frank diabetes occurs in 10 to 15 per cent of the patients, and a larger number have abnormal glucose tolerance curves.

The laboratory tests available for the evaluation of pancreatic function have been limited. During an acute attack of pancreatitis, an elevated serum amylase level is usually present. This elevation is usually transitory and returns to normal in a matter of hours. Quantitative urinary amylase determination may demonstrate an increased excretion of amylase when an elevated blood level has been missed by inopportune taking of a blood sample. Serum lipase levels also rise during an acute episode of pancreatitis. The elevation is slower than in the case of amylase and the elevation persists for a longer period of time, frequently for several days.

Until recently, methods for evaluation of pancreatic function in patients not suffering from pancreatitis have been difficult and inconclusive. Analysis of duodenal contents after stimulation with secretin has given useful information in some cases. More recently, I^{131} tagged protein and fat test meals have been used to make simple, reproducible tests of the external pancreatic secretions.[2, 3, 6] Coffey[4] has shown that the serum turbidity, as measured by spectrophotometric methods following the oral administration of olive oil, produces a curve identical with that obtained with I^{131} tagged triolein. This eliminates the necessity for isotopes. The internal secretion of the pancreas is not fully understood and useful clinical tests are limited, for practical purposes, to the diagnosis of diabetes and glucose tolerance tests.

Because of the frequent association of biliary and pancreatic disease, this study has been undertaken in an attempt to evaluate pancreatic function in patients who present themselves for treatment of diseases of the biliary system. Two methods of study have been utilized. The first method is an approach to the internal secretions of the pancreas. The records of diabetic patients who have had a cholecystectomy in this hospital have been reviewed in an attempt to determine if correction of the biliary pathology will improve the diabetic condition. The second method is a measurement of the external pancreatic secretions in patients who present themselves for treatment of diseases of the biliary system by means of I^{131} tagged protein and fat test meals.

METHODS AND RESULTS

For the purpose of determining the effect of cholecystectomy on diabetes mellitus, the records of all diabetic patients in whom a cholecystectomy was performed in the past 10 years in the John Sealy Hospital, Galveston, Texas, were reviewed. There were 44 patients in this category.

For the purpose of evaluating the external pan-

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TABLE 1

Age distribution of diabetic patients undergoing cholecystectomy

Age	No. of Patients
years	
30 to 39	7
40 to 49	6
50 to 59	13
60 to 69	11
70	7

creatic secretions, all patients admitted for surgery of the biliary system were given an I^{131} labeled fat test meal, and/or an I^{131} labeled protein meal. Measurements have been made on 23 such patients.

Effect of Cholecystectomy on Diabetes Mellitus

Of the 44 patients with diabetes mellitus who had a cholecystectomy performed, there were 38 women and 6 men. The age ranged from 33 to 75 years, with the age distribution shown in table 1. The common bile duct was explored 6 times and common duct stones were removed 5 times in this group of patients. In these respects these patients appear to be a fairly representative group of cholecystectomies. It would be expected that diabetes mellitus in such a group would be a relatively stable condition as far as progression of the diabetes is concerned, assuming that other factors such as diet control, weight control, and control of intercurrent infections remain constant.

Whether the gall bladder disease or diabetes mellitus occurred first in these patients is difficult to evaluate. Mild diabetes, not requiring insulin, may be present many years before a diagnosis is made. Similarly, relatively asymptomatic gallstones may be present for some time before they are discovered. In reviewing the records of this group of patients, a diagnosis of diabetes preceded gall bladder symptoms in 15 cases, whereas definite symptoms probably due to gall bladder disease preceded the diagnosis of diabetes in 11 cases. Both gallstones and diabetes were discovered at the same time (±2 months) in the other 18 cases.

For the purpose of evaluating the status of the diabetes in these patients, the insulin dosage of patients requiring insulin has been recorded during the year before admission and at the time of admission for cholecystectomy. Insulin dosages were sometimes changed after admission so that the insulin dosage on the day before operation has been recorded. The insulin dosage at the time of discharge and at follow-up examination has been recorded whenever possible.

In 16 patients, no insulin was required at any time during the period of observation and up to 1 year postoperatively, so that the effect of cholecystectomy on the diabetic state of these patients cannot be determined. The other 28 patients required insulin at some time during the period of observation; comparison of the insulin requirements is shown in table 2. Of the 28 patients, 21 required the same or less insulin on discharge than on admission; 7 patients required more insulin at discharge than on admission. Of these 7 patients, 2 were new diabetics diagnosed during admission so that increased insulin at discharge was expected. The other 5 were known diabetics who required an increased amount of insulin at the time of discharge for proper control.

Abramson[1] has reported that improvement (sometimes dramatic) in the diabetic state may be expected in the majority of patients subjected to cholecystectomy. He feels that the most important comparison of insulin requirements is between the day before operation and the time of discharge; and that the former is important because it reflects the insulin requirement under rigid hospital diet control and insulin management. In the present series, a comparison of the insulin requirements in this group revealed that 10 patients required less insulin at the time of discharge, 6 required more, and in 12 the requirement was unchanged (table 3).

Eisele[5] has reported that no change in the average insulin requirements of a group of diabetic patients subjected to cholecystectomy could be demonstrated, as measured by the insulin requirement 1 year preoperatively and 1 year postoperatively. In the present series, ade-

TABLE 2

Comparison of insulin requirements at time of admission for cholecystectomy and at time of discharge following operation

Requirement	No. of Patients
Insulin on admission greater than on discharge	14
Insulin same on admission as on discharge	7
Insulin at discharge greater than on admission	7

quate follow-up was available for comparison in 13 of the 28 patients. The insulin requirement 1 year before operation and 1 year following operation is shown in table 4. The majority of these patients had a greater insulin requirement 1 year postoperatively as compared to the requirement 1 year preoperatively.

I^{131} *Tagged Test Meals in Patients with Biliary Disease*

Radioiodine tagged fat and/or protein test meals have been administered to 23 patients. Of these, 20 were uncomplicated cases of cholelithiasis. One patient had postnecrotic cirrhosis and had normal absorption; 1 patient with chronic calcific pancreatitis had abnormal absorption as did 1 patient with carcinoma of the pancreas obstructing the common duct. The results in these 3 cases are to be expected and are in accordance with the reported experiences of others.[8] The other 20 cases are the important ones in this series because they represent patients with no clinical evidence of pancreatic dysfunction.

After administration of an I^{131} tagged fat test meal in a normal patient, less than 2 per cent of the ingested fat will be excreted in the stool.[3]

TABLE 3

Comparison of insulin requirements on day before operation and at discharge

Requirement	No. of Patients
Insulin greater 1 day before operation than on discharge	10
Insulin same 1 day before operation as on discharge	12
Insulin less 1 day before operation than on discharge	6

TABLE 4

Comparison of insulin requirements 1 year before cholecystectomy and 1 year following operation

Requirement	No. of Patients
Insulin greater 1 year before operation than 1 year postoperatively	5
Insulin same 1 year before operation and 1 year postoperatively	1
Insulin greater 1 year postoperatively than 1 year before operation	7

TABLE 5

Results of I^{131} tagged fat test meal in 20 patients with biliary calculi

Results	No. of Patients
Normal	8
Borderline	5
Abnormal	7

The test was originally done by administering charcoal with the radioactive fat and collecting stools until no more charcoal came through and counting the specimen. Measurement of serial blood specimens after administration of the test meal has been found to be as dependable as measurement of the feces and has made the test much simpler and quicker. Blood specimens are taken at 2, 4 and 6 hours, and by calculating the blood volume the total circulating amount of the ingested fat is determined. This is expressed as a per cent of the amount administered. In a normal patient 5 to 10 per cent should be measured on the 2-hour specimen, and 10 to 20 per cent on the 4-hour specimen. The 6-hour specimen usually shows a variable amount less than the 4-hour specimen, but in cases where there is delayed gastric emptying, the curve may not reach its peak until 6 hours after ingestion.

The results in these 20 patients are shown in table 5. All patients have been classified as normal who reached a peak of at least 10 per cent on the 4- or 6-hour specimen. The patients listed as borderline reached a peak of 8 to 9.9 per cent. Although they are below the normal range by definition, the abnormality is so slight that they may be only normal variants and these are considered normal in this study. However, there were 7 patients whose peak did not reach 8 per cent and x-ray revealed adequate gastric emptying. These cases have abnormal fat absorption.

Although this test is relatively new, it is known to be abnormal in cases of chronic relapsing pancreatitis, carcinoma of the pancreas, sprue, similar malabsorption syndromes, and regional ileitis.[8] Shingleton and co-workers[7] have reported that after a Billroth II gastrectomy ½ of patients have impaired fat absorption, whereas fat absorption is normal following a Billroth I gastrectomy. Small series of patients with cirrhosis, ulcerative colitis and functional gastrointestinal disturbances have been reported to have normal blood levels.[8]

In the present group of 20 patients with gall-

stones, 13 had relatively normal and 7 definitely abnormal fat absorption curves. In 5 of these 7 there was no evidence of any of the above conditions to account for the decreased fat absorption; 2 of these 7 were several days postoperative and had T-tubes in the common biliary duct. Although most of the bile was going into the duodenum, these 2 cases probably should be excluded on theoretical grounds, since it is known that bile in the intestine aids in the digestion and absorption of fat and fat soluble vitamins. There was no evidence of obstruction to the bile ducts in any of the other cases, so that this mechanism could not have affected any of the other tests. Thus in this group of 20 patients, if the 5 borderline tests are considered normal and if the 2 cases with some external biliary drainage are excluded, there remain 5 patients or 25 per cent who have abnormal fat absorption curves. These patients had no evidence of any of the conditions that have been reported to alter the fat absorption test. The only obvious condition that these patients have in common is the presence of gallstones. Because of the frequent association of clinical pancreatitis and biliary disease, it is very possible that the pancreatic dysfunction noted in these patients is related to the biliary pathology present. Although this group of cases is too small to justify any conclusions, it is suggestive that pancreatic dysfunction of a subclinical degree occurs in a larger percentage of patients with biliary disease than is currently appreciated. It is felt that observation of a large series of patients for a longer period of time is necessary in order to establish the significance of this observation.

The above discussion of the I^{131} tagged test meals has been limited thus far to the results obtained in the fat test meal because a fat absorption test was performed in all cases. In 12 of these patients an I^{131} tagged protein test meal was also performed. One of these was the patient with relapsing calcific pancreatitis and both the fat and protein absorption were abnormally low. The patient with carcinoma of the head of the pancreas obstructing the common duct also had abnormally low protein absorption. The remaining 10 protein test meals were performed in patients with cholelithiasis. Of these, 6 had normal fat and normal protein test meals; 2 patients who have been classified as borderline fat absorption had normal protein test meals; 1 patient with abnormally low fat absorption had a protein absorption that was classified as borderline; and 1 patient with borderline fat absorption also had borderline protein absorption.

DISCUSSION

As mentioned previously, Eisele[5] reported the results of gall bladder surgery in 76 patients with diabetes mellitus treated over a 16-year period. He concluded that removal of a diseased gall bladder would neither heal nor lessen the severity of the diabetic state, as measured by the insulin requirements 1 year preoperatively and 1 year postoperatively. Abramson[1] reported that with individual evaluation of each case instead of group averages, most patients with diabetes who are subjected to cholecystectomy will have an improvement in the diabetic state. In our present series the majority of patients required more insulin 1 year postoperatively than they required 1 year preoperatively. Although a number of other factors enter into the insulin requirements of diabetic patients during a 2-year period of observation such as this, including changes in diet, weight, development of intercurrent infections, and natural variations in the severity of the disease, it can be seen that no prolonged beneficial effect of cholecystectomy occurred.

If the comparison of insulin requirements between the time of admission for cholecystectomy and the time of discharge following operation is considered, the influence of some factors, such as natural variation in the severity of the diabetes, will be lessened. In the present series, 14 patients required more insulin on admission than at discharge, 7 required the same amount and 7 required more insulin. The part that cholecystectomy played in the improvement noted in the majority of this group is difficult to evaluate. Elimination of any source of infection will improve the diabetic status. Therefore, removal of an acutely inflamed gall bladder or elimination of other foci of infection would be expected to lessen the insulin requirement. In our series of 44 patients only 5 had demonstrable infection (4 cases of acute cholecystitis and 1 case of chronic pulmonary infection). The 4 patients who had cholecystectomy for acute cholecystitis required no insulin at any time during observation. The 5th patient was taking 12 units on admission but was controlled by diet alone on discharge. In cases of simple cholelithiasis, the factor of infection in the gall bladder would seem to be unimportant and the removal of such a gall bladder was not considered as elimination of a focus of

infection. It seemed more probable that the improvement in insulin requirements between the time of admission and the time of discharge was due to strict diet control and hospital management of the diabetes. The fact that 7 patients required more insulin at discharge than at admission seems to support the concept that any change in insulin requirement was due to medical control of the diabetes rather than the cholecystectomy.

Additional evidence in favor of this concept can be seen in table 3 which shows the comparison of insulin requirements on the day before operation and at the time of discharge. Patients were optimally controlled after a few days in the hospital on diet and insulin management. The major change between the day before operation and the time of discharge was the operation itself. Therefore, if an immediate beneficial effect of cholecystectomy occurred, it should be reflected in the figures in table 3. Actually, 12 patients were unchanged, 10 required less insulin at discharge and 6 patients required more insulin. Therefore, no consistent improvement in the diabetic status is noted immediately postoperatively. Although improvement in this period has been reported by Abramson,[1] it seems unlikely that an injured pancreas could accomplish any significant degree of recovery in the short period of a few days. The insulin requirements 1 year postoperatively failed to demonstrate later beneficial effect. The only conclusion that can be drawn from this series of patients is that no consistent improvement in the diabetic status following cholecystectomy can be demonstrated immediately postoperatively or 1 year later.

SUMMARY

In an attempt to evaluate pancreatic function in patients with biliary disease, all diabetic patients who have had a cholecystectomy performed in this hospital in the past 10 years have been reviewed in an attempt to determine if removal of a diseased gall bladder will have any influence on the diabetic status of these patients. The insulin requirements of these patients during the year before operation, at time of admission for cholecystectomy, on the day before operation and during the postoperative follow-up period have been compared. No consistent improvement in the diabetic state that could be attributed to cholecystectomy was observed. It is felt that any change in the insulin requirements of these patients is due to medical management of the diabetes and not to cholecystectomy.

In an attempt to evaluate the external secretory function of the pancreas in patients with no clinical evidence of pancreatic dysfunction, I^{131} tagged fat and protein test meals have been administered to 20 patients with biliary disease. Of these, 5 (25 per cent) had definitely abnormal fat absorption in the absence of any of the conditions that have been reported to alter fat absorption. Although the number of patients is too small to justify any conclusions, this observation is suggestive that subclinical pancreatic dysfunction occurs more commonly in biliary disease than is currently appreciated.

Acknowledgment. We would like to express our appreciation to Dr. C. H. Agnew, director of the radioisotope laboratory, for his cooperation and assistance in performing the I^{131} tagged fat and protein test meals.

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RECURRENT SYMPTOMS OF PARTIAL OBSTRUCTION DUE TO REDUNDANT SIGMOID COLON*

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Anatomical variations or borderline departures from the normal in the gastrointestinal tract seldom require consideration by the surgeon for operative treatment. Redundancy of the sigmoid colon is one of the borderline variants which is not often given serious attention either with regard to the symptoms it may produce or as a differential diagnostic possibility. Well documented clinical and roentgenographic surveys[5] of the distal colon indicate, however, that redundancy occurs in 15 to 25 per cent of the general population, that it is present in about 60 per cent of all patients with chronic constipation and in 100 per cent of patients with volvulus of the sigmoid colon.

It is the purpose of this article to focus attention not upon the readily recognized acute fulminating volvulus of the sigmoid colon and its well established emergency surgical treatment, but upon the recurrent symptoms of partial obstruction due to redundancy which do not represent complete volvulus. The syndrome to be described, when caused by this redundancy, can be cured by a simple sigmoid colectomy.

SURGICAL ANATOMY

The normal sigmoid colon begins at the medial border of the left psoas major muscle as a continuation of the descending colon, and ends at the level of the third sacral vertebra descending distally as the rectum. It usually measures 40 to 43 cm. in length but may vary from 12 to 84 cm. in length.[1] Its normal position is well within the confines of the bony pelvis.

The mesocolon is a fan shaped fold, short at each end and long at its midportion. The root is attached along an inverted V-shaped line, one limb of which runs up close to the medial border of the left psoas major as high as the bifurcation of the common iliac artery, or higher, where it bends at an acute angle and forms the second limb. This descends over the anterior aspect of the sacrum to the level of the third sacral vertebra where it ends as the sigmoid colon becomes rectum. When it ascends into the abdomen proper by reason of redundancy, the mesentery is pulled up with it to fold upon itself; and the surface which is the posterior aspect in the pelvis becomes the anterior aspect as the loop becomes abdominal in location. The longer the mesentery, the more it is folded upon itself in the condition of redundancy; and the closer the fixed points at the mesenteric root with relation to the length of the mesocolon, the easier it is for volvulus and near volvulus to develop.

PATHOLOGIC PHYSIOLOGY

During the course of normal motility of the redundant sigmoid colon, twists of the redundant segment are easily and frequently produced; recovery without symptoms follows if the twist is not excessive. A twist of 180 degrees in the bowel will produce axial torsion of the proximal and distal loops and a sharp fold in the attached mesentery and blood vessels.[2, 4] This amount of distortion can strangulate the venous and lymphatic supply and produce congestive edema, thereby initiating the vicious cycle of strangulation with volvulus. Lesser and nonstrangulating torsions probably occur often in the redundant segment with complete recovery after varying periods of time and should be considered within the limits of normal function for this anatomical abnormality. If the substrangulating twist is prolonged, if the muscular tone is poor during the twist, and if there is constipation, edema, inflammation, or any force which delays the recovery of the bowel from the twisted position, the normal flow rate of feces and gas will be reduced or stopped and there will develop disten-

The opinions or assertions expressed herein are those of the authors, and are not to be construed as official or as necessarily reflecting the views of the Medical Department of the Navy or the Naval Service at large.

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tion of the sigmoid loop and proximal bowel with varying symptoms of pain, cramps, malaise and vomiting. Recovery is the rule, but not without considerable discomfort to the patient. It may be spontaneous as a result of increased pressure in the colon proximal to the sigmoid loop, which forces the loop open and sometimes produces a mild diarrhea; but outside help in the form of change of position, exercise, enemas, sigmoidoscopy and manipulation at fluoroscopy is sometimes needed. The pathologic process tends to be progressive with increasingly severe signs and symptoms of partial obstruction, and prolonged attacks may eventually lead to strangulation volvulus.[4]

CLINICAL FINDINGS

From the pathologic physiology it is logical to expect that the range of symptoms and signs, short of actual volvulus, produced by redundancy, is quite wide and variable. Most of the patients give a history, several years in duration, of gradually increasing constipation and frequent abdominal distention.[3] Cramping abdominal pains of varying severity are frequent complaints. These are often relieved by change of position or by an enema and sometimes they disappear spontaneously.[4] Vomiting is usually a late complaint and is probably produced reflexively. In mild attacks the stool is usually of normal size and consistency, but after more severe episodes in which there is prolonged constipation and a measure of obstruction, diarrhea often marks the recovery phase. In a few instances the stool may be bloodstreaked.

Physical examination is usually negative unless the examiner is fortunate enough to see the patient during an acute episode and then there is abdominal distention and tenderness over the lower abdomen with maximal tenderness often a little to the left of the midline. In some instances the distention is marked and may be the most prominent feature of the positive findings.[3] The soft, gas filled bowel may be palpable. Signs of peritoneal irritation and firm, discrete masses are not characteristic of this condition, and if present are indicative of other disorders. Bowel sounds range from normal to hyperactive and high pitched. Rectal examination rarely reveals abnormality, but is useful to help rule out other disease in the distal bowel. Sigmoidoscopy, also important in ruling out other pathologic conditions, may demonstrate acute axial rotation of the bowel, and this evidence of obstruction without mucosal change is suggestive of redundant sigmoid colon when present. The twisted loop may be reduced by this examination but it is not recommended as a definitive method of treatment.

DIAGNOSIS

The diagnosis of redundancy of the sigmoid colon is made by evaluation of all the information available. Clinical suspicion, careful history and physical examination, and barium enema are the most dependable methods of study. The diagnosis, often as an incidental finding, can be established radiographically when the superior margin of the sigmoid loop extends well above the intercristal line of the bony pelvis after the colon is distended with barium or air. There is normal peristaltic function in the redundant loop, and there is no narrowed segment devoid of peristalsis as seen in congenital aganglionic megacolon. Confirmation of the diagnosis is made by exploration and palpation of the bowel at the time of operation, after all other etiologic conditions are ruled out.

TREATMENT

When the diagnosis of redundancy of the sigmoid colon has been established, the surgeon must use his most considered judgment to decide if sufficient indication for surgical treatment exists. It is obvious that the finding of redundancy alone does not in any sense constitute an indication for operating. It is only when the signs, symptoms, and findings are definitely linked to the sigmoid redundancy in cause-and-effect relationship that indication for surgical intervention exists. The final indication for resection must come in the operating room where abdominal exploration is necessary to rule out all other possible causes for the symptomatology. In this event the segment is found to be normal in appearance, caliber and motility, but quite obviously elongated and easily twisted on its long mesentery. Simple resection of the redundant intestine with end-to-end anastomosis is the recommended treatment. If proper judgment has been exercised, the operation may be expected to produce complete and lasting relief.

CASE REPORTS

Three cases of symptomatic redundant sigmoid colon at this Hospital are presented here with follow-up study periods of 2 to 18 months.

FIG. 1 (case 1). *Left*, roentgenograph taken after barium enema, showing redundant sigmoid colon filled with contrast material and air. *Right*, roentgenographic examination 18 months after removal of 15 cm. of sigmoid colon, disclosing normal configuration.

Case 1. P. W., a 31-year-old Caucasian woman, was admitted to the Surgical Service on May 17, 1957, complaining of intermittent abdominal pain and distention of 10 years' duration. There were 5 to 6 episodes each year, and she found relief by elevation of the lower extremities and pelvis. A more severe episode with vomiting occurred 10 days before admission to the hospital, and she passed a bloody mucoid stool at this time.

Physical examination revealed a tender mass, approximately 5 cm. in diameter, palpable in the cul-de-sac. Sigmoidoscopic examination showed an axial twist of the bowel with obstruction at the 15-cm. level. The examination manipulation relieved the obstruction.

A barium enema revealed a redundant sigmoid colon (fig. 1, *left*). Complete diagnostic studies were negative except for evidence of a chronic urinary tract infection, which was not thought to be related to the abdominal condition.

On May 20 a sigmoid colectomy was performed as an elective procedure. Approximately 15 cm. were resected, and an end-to-end anastomosis was done. The patient made a satisfactory recovery and was discharged on the 8th postoperative day. Since the resection, she has been completely relieved of the abdominal cramps and distention that had been recurring for 10 years, although the urinary tract infection continued to be intermittently symptomatic.

The barium enema study 18 months after the operation demonstrated a normal configuration of the sigmoid colon (fig. 1, *right*).

Case 2. L. S., a 38-year-old Caucasian woman, was admitted to the Surgical Service on April 16, 1957, complaining of cramping abdominal pain, distention, vomiting and a 35-pound weight loss. This was her 18th admission to this Hospital in 3 years, and the history included four cesarean sections, a panhysterectomy, a nephropexy, bilateral oophorectomies, a presacral neurectomy and adhesiotomies. She had 13 hospital admissions in 3 years for abdominal cramping pains, distention and vomiting; and a long tube was used on 8 occasions.

Countless roentgenographic examinations revealed nonlocalized variable pictures of large and small bowel obstruction of a partial degree. A barium enema showed redundancy of the sigmoid colon (fig. 2, *left*).

Physical examinations consistently disclosed abdominal distention of varying degrees of severity with slightly hyperactive bowel sounds. Tenderness was variable in all quadrants at different times. No masses were palpable.

On May 25 an elective sigmoid colectomy was performed. The lower colon was markedly redundant and 35 cm. were removed. The abdomen was remarkably free of adhesions. An end-to-end anastomosis was done. The patient's recovery was slow and protracted because of the poor physical condition preoperatively, but by the 6th month after the resection she had gained back most of

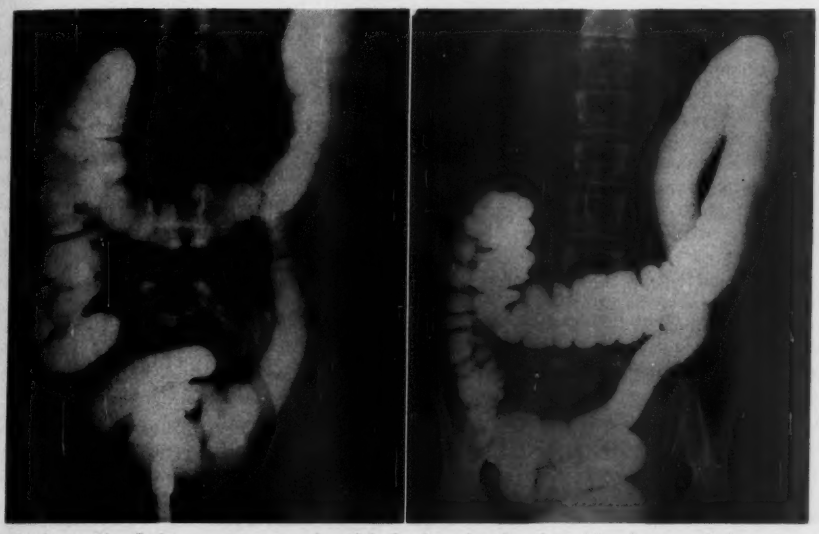

FIG. 2 (case 2). *Left,* roentgenograph with barium in the sigmoid colon, outlining several redundant loops. *Right,* roentgenographic examination after removal of 35 cm. of sigmoid colon, visualizing distal bowel within normal limits.

FIG. 3 (case 3). *Left,* roentgenograph after air contrast barium enema, demonstrating marked redundancy of the sigmoid colon. *Right,* roentgenographic examination after the removal of 40 cm. of sigmoid colon, demonstrating slight narrowing at the anastomotic site with normal configuration.

her weight and strength and was asymptomatic for the first time in over 3 years. She has remained free of symptoms, and follow-up barium enema examination 18 months postoperatively showed the distal bowel to be within normal limits (fig. 2, *right*).

Case 3. S. D., a 41-year-old Caucasian woman, was admitted to the Surgical Service on August 25, 1958, complaining of abdominal distention, nausea and vomiting of 5 years' duration. She had episodes of left upper and lower abdominal pains which were cramping in nature, with increasing

severity and frequency until they were occurring once a week, and lasting 1 to 2 days in the few weeks before admission. On several occasions when hospitalization was required, withholding of oral intake and enemas gave relief.

Physical examination revealed tenderness in the left lower abdomen and moderate abdominal distention. Roentgenographic studies demonstrated a redundant sigmoid colon and findings thought to represent a diverticulum of the duodenum (fig. 3, *left*). An elective partial sigmoidectomy was performed on August 29, and approximately 40 cm. were removed with end-to-end anastomosis. A large diverticulum of the jejunum was also removed. This was thought to be incidental to the abdominal symptomatology. Recovery from the operation was uneventful.

In the 6½ months following surgical treatment, the patient has had no more episodes of abdominal pain. A postoperative barium enema showed slight narrowing at the anastomotic site with a normal configuration of the colon (fig. 3, *right*).

SUMMARY

A syndrome is described in which recurrent episodes of abdominal pain are attributed to redundancy of the sigmoid colon. The symptoms are characteristic of intermittent partial colon obstruction but do not progress to actual volvulus.

The treatment for this condition is resection of the excess colon, but the indications for surgical intervention must be sharply limited to those patients with the symptoms described and the demonstration of redundant sigmoid colon by barium enema. Careful evaluation of the symptoms is mandatory, since the roentgenographic findings are commonly seen in the absence of symptoms and alone do not justify surgery.

The diagnosis may be considered established when other causes for the symptoms and signs have been ruled out by thorough study, by negative abdominal exploration in the operating room, and by unequivocal relief of symptoms following sigmoid colectomy.

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THE KIDNEY AND THE SURGEON

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It is the purpose of this paper to outline a simple and accurate routine for the evaluation of renal function and emphasize the role that the kidney may play in a disturbed postoperative course. Urine is but the shadow of renal activity and renal lesions may be of serious proportions without presenting disturbing signs either subjectively or objectively. We must constantly be on the alert to recognize a serious kidney deficiency if we are to afford the patient a safe postoperative convalescence.

The most valuable laboratory study indicative of renal ability is the time honored, though too often little respected, urinalysis. The test for glycosuria is usually methodically undertaken; the determination of albumin, with disinterest; and the microscopic study, with tolerated boredom; the specific gravity is frequently cast aside upon the slightest provocation with the notation, "Q.N.S." From the surgical standpoint the specific gravity, in this chemotherapeutic era, is infinitely more valuable than the microscopic examination. There is seldom a valid excuse for recording, "Q.N.S." Urinometers are available that will measure the gravity of almost any urine specimen that reaches the laboratory; only a few cubic centimeters are required.

The specific gravity of the urine affords valuable information as to the patient's state of hydration which in the face of a large fluid ingestion will produce a dilute urine. If, on the other hand, the patient has been consuming the average quantity of fluid, a distinctly dilute urine should suggest the possibility of renal disease which has disturbed the kidneys' ability to concentrate urine. In this latter instance the physician must be alert to the possibility that the patient is retaining metabolic by-products in spite of an average urinary output which is of low specific gravity and is evidence that the daily urinary waste products are not being ejected.

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 9, 1959.

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An afebrile man must excrete 35 gm. of metabolic waste products through the urine each day. The normal kidney can accomplish this with as little as 483 cc. of fluids per day; whereas, if the kidney concentrates only to 1.015 it requires 850 cc., when the maximal renal ability of concentration is 1.010 it requires 1439 cc. It is quite apparent that the specific gravity of the urine coupled with only the usual routine information on the patient's chart provides the physician with a practical estimate of renal efficiency.

Realizing that every patient postoperatively must excrete a minimum of 35 gm. of nitrogenous waste material daily and the fluid to accomplish this is dependent upon renal function, makes the importance of preoperative renal function determinations apparent. Furthermore, let us not forget that the usual urea nitrogen, nonprotein nitrogen and creatinine blood studies do not necessarily become abnormal until glomerular filtration is less than 25 per cent of normal. And even more important, that the liver is the site of urea formation so that the blood urea nitrogen figure or the nonprotein nitrogen may remain at a normal level in the presence of severe hepatic disturbance in spite of a profound renal failure.

The renal clearance tests are by far the most accurate tests for kidney function; however, their complexity negates their use in routine hospital practice. On the other hand, the dye phenolsulfonphthalein (PSP) is removed from the blood both by the renal tubules and glomeruli and thus its excretion reflects the renal blood flow which in turn parallels the extent of renal disease. The simplicity of this test affords an excellent clinical means of estimating renal function.

It is mandatory that the dye, phenolsulfonphthalein (6 mg.), be given intravenously for dependable absorption and that the patient is well hydrated. Immediately before the test, 10 ounces of water must be consumed. The patient is asked to void in 15 minutes after the injection of the dye. If the concentration of the phenolsulfonphthalein exceeds 30 per cent the patient's renal status can safely be considered to be within clinically normal limits. This is a

simple and accurate test which can be readily executed in the office or hospital with minimal personnel and utmost confidence.

The phenolsulfonphthalein test represents renal blood flow of the glomerulus and proximal tubules, whereas the specific gravity of the urine is a measure of the distal tubule activity and when these two functions are comparably normal the picture of renal function is reliably outlined. However, in the event that the patient cannot concentrate urine it is important to determine the blood values of sodium, chloride and carbon dioxide combining power of the blood even if the nonprotein nitrogen level of the blood is normal, since the latter is but a reflection of glomerular activity and there may be marked electrolyte changes secondary to distal tubular malfunction associated with a normal nonprotein nitrogen level.

Assuming that our patient has relatively normal kidney function what would be the most efficacious method of handling the fluid requirements postoperatively? In the first 24 to 48 postoperative hours, the use of glucose and water is mandatory. Any solution containing electrolytes or saline should be avoided. Normally, during this period, the postoperative patient excretes no more than 1.5 to 3.0 gm. of salt per 24 hours, which is less than the salt contained in 300 cc. of physiologic saline solution. Therefore, any excess of sodium ion introduced is transferred to the extracellular space which in turn increases the interstitial osmotic pressure and attracts water thus robbing the circulatory system and the kidneys of available water. Incidentally, Moyer[2] has pointed out that, particularly in elderly patients, the incidence of pulmonary complications following upper abdominal surgery is materially increased when saline is infused during the first 48 hours. In short, the patient is in need of water during this early postoperative period; not salt. As Schemm[3] has so aptly said, ". . . brine is not water."

The patient's volumetric fluid requirements are dependent upon the initial state of hydration, the cardiovascular picture and the febrile state. If the patient is losing gastrointestinal fluid by either suction or vomiting the fluid volume must be replaced volumetrically and chemically by a balanced electrolyte solution such as Hartman's or Talbot's solution. Replacement with saline alone is not the answer, since vomitus or the fluid from gastric suction contains 2.5 times the amount of potassium that is normally present in the plasma. If the potassium is not replaced the symptoms of hypopotassemia may occur in a most insidious manner. Hypopotassemia is associated with a generalized muscular weakness which may be considered an anticipated normal postoperative occurrence. The muscular apathy involves the intestinal musculature and a resultant abdominal distension ensues that is refractory to all the time tested measures to relieve distension. A flat plate of the abdomen demonstrates both the large and small bowel distended. The correction of the electrolyte pattern affords a miraculous cure.

In the event of dehydration, what is the practical clinical approach to this problem? First, the history; noting particularly the mode of onset, its duration, fluid volume lost, degree of thirst and the ability of oral fluid retention. Second, the examination of the tongue; the elasticity of the skin and the presence or absence of edema. Third, the laboratory further clarifies the problem when the hematocrit is compared with the erythrocyte count to demonstrate the degree of hemoconcentration (normal hematocrit in the male is 40 to 54 per cent and in the female 37 to 47 per cent). Furthermore, the hematocrit affords a simple and accurate yardstick for following the progress of hydration.

The importance of total plasma protein must not be forgotten, since when this level falls below 5.5 gm. per 100 cc. fluids escape into the extravascular spaces and profound oliguria may appear in spite of adequate hydration. The reduced plasma volume is associated with a reduced arterial pressure which in turn diminishes the renal filtration pressure. The increased viscosity of the blood further retards the blood flow, which may effect both the excretory and absorptive functions of the kidney and materially influence fluid and electrolyte economy. Hence, simple vascular dehydration can materially effect the entire electrolyte picture and lead the unwary physician into a path of dangerous electrolyte therapy.

Occasionally, postoperative oliguria may be a result of the antidiuretic effect of morphine or Demerol and, to a lesser extent, the barbiturates.[1] Although rare, it demands recognition. The sedative effect of 5 per cent alcohol in 5 per cent glucose in distilled water (500 cc. of 95 per cent

grain alcohol added to 1000 cc. of 5 per cent glucose in water) will afford sufficient sedation to permit a marked reduction or total withdrawal of the narcotic or barbital and solve the troublesome oliguria. In the final analysis it is quite apparent that the preoperative determination of renal function is most important when one is confronted with these puzzles of electrolyte imbalance and azotemia.

In conclusion it may be mentioned that the artificial kidney by virtue of blood dialysis provides a means of balancing a patient's electrolyte pattern before surgery wherein the surgeon is of the opinion that his operative procedure will materially benefit renal function. Thus, with a relatively normal preoperative electrolyte picture it may mean the difference between a successful and unsuccessful postoperative course. Obviously, these situations will be rare, but are at least worthy of mention and provide a wide frontier for exploration.

SUMMARY

The importance of preoperative consideration of renal function is discussed along with simple methods of accurately estimating renal function. The fundamentals of fluid therapy are discussed along with brief mention of preoperative dialysis in instances of electrolyte imbalance.

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ANORECTAL TUBERCULOSIS

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Tuberculosis of the large bowel is usually a complication of pulmonary tuberculosis and like pulmonary tuberculosis usually affects persons before middle age.

Buie[2] states that at the Mayo Clinic 10 years were required to collect records of 107 patients who had tuberculosis of the colon. In these, the rectum alone was involved in 3 cases. He states further that about 1 in every 416 patients who presented symptoms referable to the colon had tuberculosis of the anus or rectum (other than anal fistula). In discussing tuberculosis as a primary etiologic factor in anal fistula, he states that it probably occurs so rarely as to be a pathologic curiosity.

Martin[4] reported 150 patients at Chicago Muncipal Tuberculosis Hospital who were examined proctoscopically. In group I there were 65 patients without abdominal symptoms who presented ulcerations through the proctoscope. In group II there were 65 with mild to moderate abdominal symptoms and 2 exhibited ulcers in the lower colon. In group III there were 20 patients with marked abdominal symptoms and with advanced tuberculosis. This group was bedfast, whereas those of the other groups were up and about. In group III there were 5 patients (25 per cent) who showed definite ulcerations. However, during proctoscopic examinations of 920 private patients, tuberculous ulcers were seen but twice.

Martin and associates,[5] working together at the same institution, give a comprehensive analysis of 200 patients admitted with a diagnosis of active pulmonary tuberculosis. They found viable and virulent tubercle bacilli in the lower sigmoid colon and rectum of ⅓ of these patients and concluded that the tubercle bacillus is the primary etiologic agent in anal abscess and fistula occurring in the tuberculous patient.

Bacon[1] reported 402 cases of anal fistula in which 7 (1.7 per cent) were tuberculous. These were all proved by guinea pig inoculation and by microscopic section of the tissues.

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 9 to 12, 1959.

Grant[3] reported a series of 5000 cases of anal fistula and found 500 of them to be tuberculous. However, there is no mention made as to the method used in arriving at a diagnosis.

In making this study and reporting a patient who came under my observation, I have been impressed by the very few cases that may be seen by the proctologist who has no connection with institutions caring for the tuberculous patient. Recently, I carefully reviewed arbitrarily the records of 846 consecutive private patients for whom I had done complete proctologic examinations. I failed to find another case where a diagnosis of tuberculous anal ulcer had been made. There were, however, many patients who presented ulcerations in the rectum, anus, or perianal region. This fact may at times pose quite a problem in differential diagnosis.

Rectal tuberculosis is generally described as: (1) ulcerative; or (2) hyperplastic. Tuberculous ulcerative changes in the rectum usually occur as a late or terminal manifestation of the disease. The spread of the infection to the lower bowel may be: (1) direct, from swallowed bacilli in either food or infected sputum; (2) by way of the lymphatics; or (3) hematogenous. It is probable that direct infection from swallowed bacilli is a common cause of this condition. The tubercle bacillus usually invades the mucosal surface of the lymph follicles, attacking the submucosa where caseated areas of necrosis occur. There is an extension of this process, the mucosa disintegrates and an ulcer is formed. This ulcer takes on an irregular, circular or elliptical shape with a grayish-yellow caseous base. The edges are sharply defined, undermined and appear elevated. The discharge is mucopurulent, foul smelling and may contain blood. The ulcers may coalesce and even extend out onto the perianal skin.

The hyperplastic type is characterized by a fibrous development which keeps pace with the destructive process of caseation and necrosis, in time forming a fibrous, inflexible, inelastic tube. This process may extend into the adjacent pelvic structures and be mistaken for malignancy.

Anal tuberculosis is usually described as (1) ulcerative, (2) lupoid or proliferative, (3) verru-

cous, or (4) miliary. The ulcerative type may be an extension of an ulcerative process of the colon and rectum. The invasion of the anal canal may be by way of the anal crypts or through the tissues of the anal canal. Rarely the invasion may be hematogenous. The process begins insidiously as a small elevation or tubercle which breaks down and an ulcer is formed. As the process extends, the epidermis breaks down leaving one or multiple ulcers whose edges are well defined, undermined, with a pale pink, sometimes purplish, color. There is usually a raised indurated area around the ulcer or ulcers. If multiple, they may be connected by subcutaneous channels. The base of the ulcer is usually dotted with yellow tubercles. There is very little bleeding and pain is minimal.

The lupoid or proliferative type is very rare. It may begin as small round elevated patches on the anal margin, between which there may be linear ulcers. These break down, ulcerate, and may extend inward to the rectum and eventually the sigmoid and colon, with linear ulcers in the long axis of the bowel. The verrucous type is also rare. It is characterized by warty or papillary growths in the perianal region, and at times extending into the anal canal. The miliary type is extremely rare and usually represents an advanced stage of tuberculosis elsewhere in the body.

Diagnosis of anorectal tuberculosis is sometimes difficult. A history of pulmonary tuberculosis with occurrence of lesions discussed above is suggestive of lower intestinal involvement. Scrapings from the ulcers, especially those involving the anal and perianal region, often show tubercle bacilli and in such cases is conclusive. Ulcerative tuberculosis of the rectum must be differentiated from stricture of lymphopathic origin and from malignancy. Perianal and anal ulcers may be confused with chancre and chancroid, whereas the verrucous variety must be differentiated from such conditions as condyloma acuminatum, condyloma latum and epithelioma. The indicated laboratory and other diagnostic procedures must be done in each case.

The treatment of anorectal tuberculosis is the treatment of tuberculosis in general, along with such surgical and therapeutic measures as each individual case requires. In case of anal fistula, eradication of this condition may relieve the patient of enough of the load he is already carrying to permit a start on the road to recovery. Any surgery should be done conservatively. The anesthetic of choice is low spinal, although caudal or sacrocaudal may be preferred by some. Perianal ulcers may respond temporarily to application of 10 per cent silver nitrate or Negatan. Warm, moist applications or hot sitz baths, if the patient can tolerate them, afford relief from pain or discomfort.

CASE REPORT

The patient was a white woman, aged 48, a nurse, and wife of a doctor. She was referred to my office in October, and gave a history of having been operated on in another city for rectal abscess 3 months previously, and of having a hemorrhoidectomy done at the same place in January of that year. She had been told by a proctologist several years ago that she had an anal ulcer. She stated that she had lost 33 pounds in the past year, was nauseated and vomited frequently, and had been running an elevation of temperature for the past 2 months. She complained of pain on bowel movement.

The proctologic examination revealed a fairly large ulceration on the posterior anal wall which appeared through the anoscope to be about 1 cm. long. It extended nearly to the anal margin and its outer border could be seen by separating the buttocks and asking the patient to strain down. The proctoscopic examination revealed an apparently normal rectum and lower sigmoid for a distance of 25 cm.

The patient was admitted to the University Hospital 2 days later for the purpose of excising the ulcer. However, she immediately began vomiting and was rapidly becoming dehydrated. She was given intravenous glucose solution and improved. She weighed 79 pounds. The urine was negative and the blood count was within normal limits. A barium enema and x-ray of the colon was done and the report was a follows: "Fluoroscopic examination showed no delay to the passage of barium through the colon, and no evidence of obstruction. The sigmoid, descending colon, and loops of splenic flexure are smooth and unhaustrated. No filling defects are demonstrated." There was moderate abdominal distension, with generalized tenderness and muscle spasm. The medical department made a working diagnosis of partial intestinal obstruction, anal ulcer and dehydration with acidosis. The temperature ranged from normal to 100°. She was treated expectantly and on the 5th day was allowed to go home, at her request.

We heard no more from her until 2½ months later when she was again admitted to the University Hospital, complaining of pain in the anal canal and high fever. There was no cough or expectoration. On examination the patient was

very emaciated and appeared to be very ill. The anal ulcer now extended out on to the perianal skin posteriorly on an area about 4 cm. in diameter. The edges of this ulcer were well defined and undermined. There was rather profuse purulent discharge. The base was granular, bled easily, and there were a few pale yellow spots in the granulations.

The medical service reported: "...a few harsh rales in the apex of the right lung. Breath sounds are essentially normal except for prolongation of the expiratory phase." An x-ray of the chest was ordered. Scrapings from the ulcer were sent to the laboratory with a request that a search be made for Donovan bodies, Ducrey's bacilli and acid-fast bacilli.

The report of the x-ray of the lungs was: "Advanced tuberculosis throughout both lung fields with evidence of cavitation in upper lobes." A specimen of sputum was positive for acid-fast bacilli as was the scraping from the ulcer. The temperature ranged from 99–102° during her 6-day stay in the hospital.

The patient was transferred to the Tuberculosis Sanitarium and died about 2 months later.

DISCUSSION

This case was of interest to those of us who saw her; first, because there was a diagnostic problem; second, the proctoscopic examination revealed none of the ulcerative lesions one would expect to find in the rectum and lower sigmoid; and third, there was the problem of treatment.

The first problem was simplified when we began searching for tuberculosis. Since no lesions were found on proctoscopic examination the anal ulcer could be due to blood borne organisms, or the tuberculous process in the anal and perianal regions could be the result of a nontuberculous ulcer becoming infected by tubercle bacilli passed in the feces. The question of treatment resolved itself into the general treatment of tuberculosis.

SUMMARY

A partial review of the literature relating to anorectal tuberculosis is presented.

A case of anal tuberculous ulcer is reported.

A short discussion of the case is given.

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LUMBOSACRAL ARTHRODESIS: AN EVALUATION OF ITS PRESENT STATUS*

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There is not complete accord among surgeons as to the most satisfactory treatment of disc disease in the lumbar spine, whether or not it is associated with posterior herniation of the nucleus pulposus. The controversies have arisen largely over the question of when arthrodesis is indicated or necessary. If attempts are made to analyze the problem, it is found that the indications for surgery, the type of fusion and the postoperative care have all been so variable that accurate comparisons of the results cannot be made. It is necessary to establish definite criteria for the selection of patients for surgery; for good evaluation of the disease process and adequate conservative care before surgery; for preoperative preparation and indoctrination of the patient for surgery; for controlled and comparable postoperative care; and for evaluating the end results, before an accurate comparative study of the results of the various surgical procedures can be made.

The purpose of this study will be to discuss these factors and to stress their importance in obtaining good end results in the treatment of lumbar spine disease. It will be emphasized that a standardized approach to the problem of evaluation must be made before comparable studies of results can be obtained. A review of the statistic studies of authors using the various techniques will be presented, with a comparison of the end results. A review of the author's end results will also be given for comparison along with changes in operative technique. It is realized, however, that any comparison of these results can only be relative, since the criteria for fusions and aftercare have been so variable.

The failure to secure a good result following arthrodesis of the low back may be the result of inaccurate evaluation or improper selection of the patient for surgery. It is necessary to evaluate the emotional state and stability of the patient, as well as the disease process in the spine, before making a final decision. One basic requisite for a candidate for fusion is the presence of some mechanical derangement in the area of the spine to be fused, but the findings must also indicate the psychologic fitness of the patient for surgery and his willingness to follow postoperative instructions. It must be emphasized that the patient should be apprised of the condition from which he is suffering, before instituting any treatment. This should include an explanation of the disease or disability in terms that can be understood by laymen. The methods of handling the problem should be outlined simply but as completely as is practical at the time. Most often it will be necessary to observe the response to simple conservative measures for a period of time before one can determine the necessity or desirability for surgery. Such a period affords an opportunity for both physician and patient to learn, and to understand each other. During this time the surgeon can evaluate the entire picture and at the same time develop the confidence of the patient. Problems may then be discussed more freely. If the surgeon finds that an arthrodesis of the spine is indicated after having carefully evaluated and observed the patient, the patient should then be apprised of all of the facets of this phase of the treatment, with the expected end results. This should include explanation of the operative procedure, its merits, the expected period of hospitalization and the postoperative care until released for normal activity. In outlining the convalescent care, the absolute necessity of following instructions and the use of all precautions to prevent any strain on the lower back is stressed. An outline of the convalescent care, together with all of the limitations of activity, is given the patient at this time. He is told that a cast or brace will be worn for several months, but that this will not completely protect or immobilize the spine, and that it will be necessary for him to use every reasonable precaution to protect the back. In order that he may better understand the necessity of protecting the back during this period, a simple explanation

* Presidential address delivered at the Annual Meeting of the Southwestern Surgical Congress, Denver, Colorado, March 30, 1959.

of the process of bone healing is made to him. The patient, having been informed of what he may expect and what may be expected of him following surgery is asked to go home and think over the situation before making a decision. It should be emphasized to the patient that the decision is one for him to make. In most instances the full understanding of the problem by the patient before surgery will make the convalescent care simple, and follow-up information easy to obtain.

ROENTGENOLOGIC EXAMINATION

There has been some divergence of opinion as to whether or not there is any method that is entirely reliable for the estimation of firm bony fusion in arthrodesis of the lumbosacral spine. The mobility roentgenogram in the lateral and anteroposterior projections has been the generally accepted method of estimation of solid bony fusion. Even this method presents difficulties that are rarely overcome. Films that will superimpose accurately are rarely obtained because of the almost impossible task of maintaining a constant relationship between the x-ray tube, the patient, and the x-ray film. One often has to decide whether the lack of complete superimposition of the films, small though it may be, is due to some motion at the intervertebral joint or merely to a slight difference in angle of projection of the films. Despite the inaccuracy of the mobility film, it is still the only visual method of assessing the solidarity of the fusion except by surgical exploration. However, one is not sure that the presence of solid bony fusion as shown by roentgenogram should be the basic criterion for estimating the result of an arthrodesis of the lumbar spine, especially when its presence cannot be accurately determined. On the other hand, one can agree with some authors that subjective tests of relief of symptoms, when used alone, are not reliable; but at the same time one believes that the clinical evaluation of the patient is just as accurate as the roentgenogram in the estimation of the functional result from the arthrodesis. The result is good when there is not any tenderness over the vertebrae, the motion of the spine is free above the fusion, and the patient is able to lead a relatively normal life without discomfort. This includes the ability to resume and to continue regular work without limitations, even though the roentgenogram does reveal some motion at the site of the arthrodesis.

TECHNIQUE

A study of the evolution of arthrodesis of the lumbar spine reveals that few and minor changes were made in the early procedures of Albee and Hibbs until the importance of the intervertebral disc and herniations of the nucleus pulposus were demonstrated by Mixter and Barr.[13] The increased frequency of fusion of the lumbar spine that followed soon after their report brought forth the realization that the existing techniques of fusion resulted in too high a percentage of failures. A number of new procedures were evolved shortly therafter in an attempt to improve the end results. Bosworth[2] adapted the clothespin graft to the lumbosacral region and reinforced it with free grafts bridging the lamina. Jaslow[9] developed a technique for posterior interbody fusion following disc removal. King[10] placed metallic screws across the apophyseal joints after excising the articular cartilage. McBride[11] developed the mortised transfacet bone block which was inserted with the vertebrae distracted. Moore[14] combined the procedures of Bosworth and McBride. The author[16] combined the principles of the procedures of King, Bosworth and Hibbs. Autogenous bone pegs were used to transfix the apophyseal joints instead of metallic screws and later the McBride transfacet bone block was added.

Several modifications of the interbody fusion have been developed. Wiltberger[18] devised a reamer and punch to make a snug fitting dowel graft. Harman[7] has developed what he terms a simple, safe interbody fusion technique through an anterior approach. Humphries and associates[8] devised a plate for anterior fixation of the vertebral bodies after fusion.

The author has modified his technique, as originally published, by changing the small transfacet peg graft to a large dowel transfacet intrapedicle graft (fig. 1), and has discontinued the McBride bone block. The change in technique includes distracting the vertebra the desired distance and maintaining this with an interspinous separator. A small drill hole is then made through the inferior and superior facet and into the pedicle. The hole is enlarged with hand reamers as much as will be tolerated by the pedicle; it will vary from $1\frac{1}{32}$ to $\frac{7}{16}$ of an inch. It is important that this hole extend through the superior facet into the pedicle far enough for the dowel to be solidly fixed so that it will not

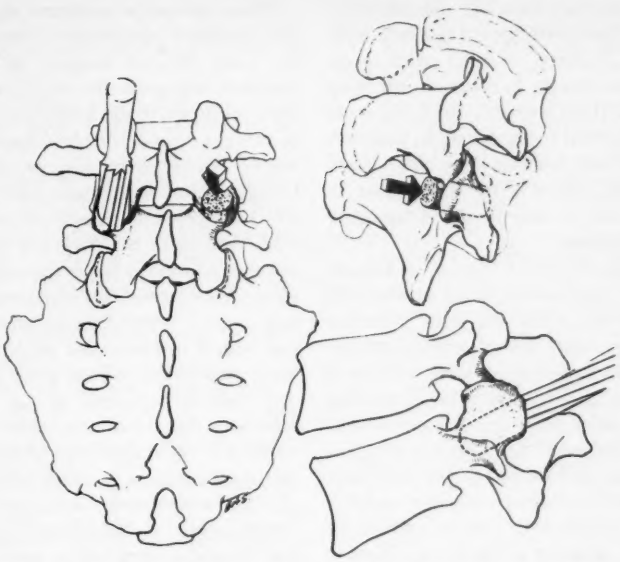

FIG. 1. Method of placing graft across facets and into the pedicle

TABLE 1

Results obtained in all series of lumbosacral arthrodesis

Author	Type of Fusion	Number of Patients	Results			
			Solid fusion by x-ray		Good clinical	
			No.	%	*No.*	%
Cleveland and associates[3]	Posterior	594	486	80*	503	84
Overton[17]	Posterior	83	79	95.2	77	92.8
Cloward[4]	Interbody	57	53	93	49	86
Cloward[5]	Interbody	354	343	97	?	?
Adkins[1]	Interbody	70	1	1.5	54	77
Nisbet and James[15]	Interbody	19	8	42	??	?
Wiltberger[18]	Interbody	46	40	87	40	87
Wiltberger and Abbott[19]	Interbody	63	52	82.5	?	?
McBride and Schorbe[12]	Posterior	377	294	78	333	88.3
Dommisse[6]	Interbody	48	28	58	44	92
Overton, 1959	Posterior	187	174	93	177	94.6

* Results were 87 per cent bony fusion when only the fourth lumbar vertebra to the sacrum was included.

loosen and tend to slip out. The dowel is made from the posterior iliac spine where the bone is heavy enough to make a solid graft. The combination of the dowel across the apophyseal joint on each side and the H graft between the spinous processes gives solid fixation of the joint, preventing either rocking or rotation. When Hibbs' interlamina chips and finely pulverized bone is used as a reinforcement, an excellent graft bed is formed.

RESULTS

In this series, 199 patients were operated on. We were able to follow 187 for more than 1 year. These patients were then evaluated using the criteria outlined earlier in this presentation. It

was estimated by x-ray that 174 (93 per cent) had solid bony fusion. Of the 13 patients with pseudoarthrosis, 2 were re-fused with good results and 3 were able to do regular work, with little discomfort. There were 177 (94.6 per cent) of the patients returned to regular work; however, 21 of these would have back or leg aching toward the end of the day. Seven of the series could do only light work, and 3 were unable to engage in any gainful occupation.

A review of the results of various techniques for fusion of the lumbosacral spine, as shown in table 1, reveals that there has been little improvement in the more recent series over the earlier ones. This fact is even more evident if one excludes the patients from the Cleveland and associates[3] series, in which the second and third, and the third and fourth lumbar vertebrae were fused. These authors had 87 per cent bony fusion when only the fourth lumbar vertebra to the sacrum and the fifth lumbar vertebra to the sacrum were involved in the fusion. Further, it will be observed that the more recently popularized interbody fusions have not improved the end results. It is noted, in making this deduction, that the results obtained by Cloward[5] indicate a higher percentage of bony fusion, but it must also be remembered that he supplements the interbody fusion with a posterior fusion.

DISCUSSION

The choice of the type of lumbosacral fusion to be done by a surgeon will usually be based on his experience with the procedure, the ease with which the technique can be followed, the likelihood of the least complications, and the knowledge of what will give him the best results. However, there are two requirements to be met by the procedure employed: (1) it should be the one that will give the most complete immobilization of the segments to be fused, and (2) it should provide a good bone graft bed and bone mass so that fusion will occur in the shortest possible period of time. It has been the dream of every orthopedic surgeon, at one time or another, that new knowledge will evolve to solve the problem of bone healing, thus eliminating the minute attention to detail that is required at the present time. However, until such time as this revolutionary accomplishment is a reality, one has to continue to use all of one's ingenuity with the knowledge available at present.

Most orthopedic surgeons are in agreement that interbody spinal fusion, mechanically, offers the most efficient method of fixation of the vertebral segments. Several improvements have been developed in the technique of this procedure pointing to more complete fixation of the segments. Even these improvements have not brought about end results superior to those in which the posterior elements were fused (table 1). One, then, asks the question: If, mechanically, interbody fusion is the best method of immobilization of the vertebrae, why aren't the results by this method better than by other methods? The one logical answer must be that the vertebral body does not provide as good a graft bed as do the posterior elements of the vertebrae. The failure of the interbody fusion to give results superior to other methods of fusion, together with the greater hazard of spinal cord and nerve root damage in the posterior approach, and of great vessel damage in the anterior approach, makes it less desirable than other methods. The intertransverse method of Adkins[1] does appear to have merit, particularly in those cases where wide laminectomy or removal of the entire loose lamina in spondylolisthesis is to be performed. However, the method has been in use for too short a time to permit an estimate of its true value. Analysis of the series of patients presented in this study would suggest that fusion of the posterior elements of the vertebrae, by the technique described by the author, offers the best and safest method for arthrodesis of the lumbosacral spine at this time.

SUMMARY

The most important problems leading to success or failure in arthrodesing operations of the lumbosacral spine have been reviewed. The importance of proper selection of patients for surgery, of the adequate preoperative preparation of the patient for surgery, and of postoperative follow-up to complete recovery has been stressed. The various methods of arthrodesing the lumbosacral spine have been discussed along with comparative studies of the end results. Finally, the requirements for the choice of the type of operation to be performed have been outlined.

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CARDIAC METABOLISM AS INFLUENCED BY ISCHEMIA, REFRIGERATION, AND ENZYME PRECURSORS*

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INTRODUCTION

In recent years the clinical feasibility of transplanting homologous tissue has been demonstrated. Merrill and associates[24] have successfully transplanted entire kidneys in identical twins. Good and Varco[9] demonstrated that homologous skin grafts may be successful in agammaglobinemic patients. Various investigators[7, 23] have worked on the problem of immunology, and have shown that the antigen-antibody reaction may be diminished by steroid therapy, or even prevented by deep roentgen therapy to the bone marrow and by nitrogen mustard.

It has been demonstrated previously[29] that isolated hearts maintained at low temperatures can survive for long periods with return to adequate clinical function. If and when the problem of immunology is completely solved, transplantation of the heart and other viscera should become a clinical possibility. Obviously, in our present state of knowledge and technique, several hours are required for obtaining the heart, preparation of the recipient, and precise surgical reimplantation.

It is hoped that present studies of metabolic changes in the heart may contribute to the possibility of its transplantation in the future and may also demonstrate methods of improving the metabolism of the refrigerated heart. The present study was designed to determine the metabolic changes of the heart after a period of ischemia and refrigeration.

First place winner of the Scientific Paper Award Contest of the Southeastern Surgical Congress.

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, Florida, March 9 to 12, 1959.

This work was supported in part by grants from the National Institute of Health (H-2806C) and the Mississippi Heart Association.

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METHODS

Donor hearts were obtained from small dogs previously heparinized with 10 mg. of heparin per kg. of body weight.[29] The hearts were either immediately transplanted to the neck of large recipient dogs or immersed in Tyrode's solution with 10 per cent serum at 4°C. for periods ranging from 6 to 8 hours.[17] The distal carotid artery of the host was anastomosed to the donor's brachiocephalic artery, and the proximal end of the recipient's jugular vein was connected by a plastic coupling to the left pulmonary artery of the donor heart. In some cases the flow from the proximal carotid artery of the recipient was shunted into the left atrium of the graft to test the effect of a work load which approximated resting cardiac output (fig. 1).[28] After restoration of normal cardiac function, blood samples were taken from the carotid artery and timed samples were collected from the pulmonary artery of the grafted heart. This pulmonary artery outflow afforded a measure of coronary flow, all of which had emptied through the coronary sinus into the the right atrium. Samples were obtained over several hours, with, and without, the addition of the work load. The blood glucose was measured by the method of Folin and Wu (1920). For determination of lactic acid, the method of Baker and Summerson (1941) was used. Determination of pyruvic acid was performed by the method of Friedemann and Haugen (1943). Oxygen and carbon dioxide determinations were done by the method of Van Slyke. After completion of each experiment, the auricles and right ventricle were carefully removed, including the trabeculae carneae and papillary projections, and the left ventricle was weighed.[10] All data are reported using the baseline of 100 gm. of left ventricular weight.

In series I, the hearts were transplanted imme-

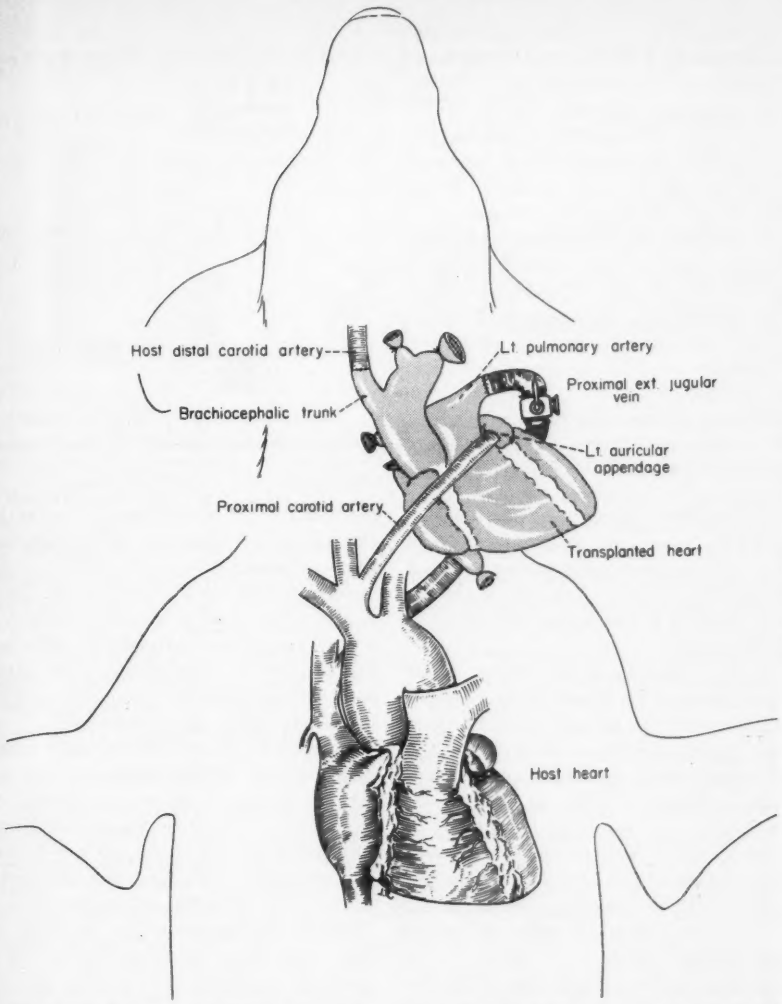

FIG. 1. This is an illustration of the transplanted heart. The distal carotid artery of the host is anastomosed to the donor's brachiocephalic artery and the proximal end of the recipient's jugular vein is connected to the left pulmonary artery of the donor. Occasionally, the proximal carotid flow was shunted into the left atrium of the donor heart.

diately after excision. Approximately 30 to 50 minutes were taken for the procedure. In series II, the excised hearts were refrigerated for periods of 6 to 8 hours, and subsequently transplanted. In series III, the hearts were refrigerated and transplanted as in series II, but 500 mg. of thiamin and 500 mg. of nicotinamide were given intravenously to the recipient dog about 30 to 60 minutes before restoration of coronary flow of the transplanted heart.

RESULTS

In series I, the 7 hearts immediately transplanted returned to adequate function. Usually the heart spontaneously resumed a normal sinus rhythm. The coronary blood flow averaged 128 cc. per 100 gm. of left ventricle per minute, ranging from 80 to 140 cc. With the addition of a work load, the coronary flow rose to 313 cc. per 100 gm. of left ventricle per minute, with a

TABLE 1

Summary of metabolic data in normal, transplanted, and refrigerated hearts per 100 gm. of left ventricle

Experimental Data	Coronary Flow		O_2	CO_2	Glucose	Lactate	Pyruvate
	Rest	Work					
	cc.	*cc.*	*cc.*	*cc.*	*mg.*	*mg.*	*mg.*
Series I							
Immediate transplant (7)	128	313	6.4	7.1	11	10	0.7–2.6
Series II							
Refrigerated (10)	180	330	10	8	4.8	4	−1.5
Series III							
Refrigerated thiamine and nicotinamide (6)	199		9.2	8.8	5.5	3.2	0.2
*Baseline data from literature**							
Extracorporeal perfused heart*			7.6	6.6	12.24	0.22	0.106

* Adapted from Jesseph and associates.[21]

range of 210 to 400 cc. The oxygen consumption averaged 6.4 cc. per minute, ranging from 4.8 to 7.2 cc. The carbon dioxide consumption averaged 7.1 cc., ranging from 5.8 to 8.2 cc., for an average respiratory quotient of 1.1 with a range of 0.7 to 1.2 (table 1).

In series II of 10 refrigerated hearts, it was necessary to massage the hearts for long periods to rewarm the heart and restore normal function. Nearly all required Adrenalin or calcium infections to increase tone, and all required electric defibrillation. Coronary flow in this group averaged 180 cc., ranging from 155 to 200 cc. per 100 gm. of left ventricle per minute. An average of 10 cc. (ranging from 7.8 to 12 cc.) of oxygen were utilized and 8 cc. (ranging from 6.2 to 10.5 cc.) of CO_2 were produced, with an average respiratory quotient of 0.8.

In series III, the 6 hearts receiving thiamin and nicotinamide did significantly better functionally than those not receiving vitamin therapy. They restarted more promptly, defibrillated more easily, and seemed much stronger. The metabolism proved to be similar but stabilized more rapidly. The coronary flow averaged 199 cc. per minute with a range from 170 to 245 cc. Oxygen and carbon dioxide utilization was 9.2 cc. (ranging from 7.2 to 14 cc.) and 8.8 cc. (ranging from 5.8 to 11.3 cc), with a respiratory quotient of 0.95.

CARBOHYDRATE METABOLISM

In series I, the hearts immediately metabolized glucose, lactate, and pyruvate, averaging approximately 11 mg. of glucose, 10 mg. of lactate, and minimal amount of pyruvate, 0.7 to 2.6 mg. per 100 gm. of left ventricle per minute. An early negative balance of pyruvate, with later improvement, was shown in 4 of the 7 hearts. The utilization of substrates was increased either by adding a work load, or by increasing the pulse rate, but this could not be quantitated. These averages of carbohydrate utilization are comparable to those found by Jesseph and co-workers.[21]

In series II, the refrigerated heart metabolized approximately 4.8 mg. of glucose and 4 mg. of lactate. The pyruvate was in negative balance, averaging −1.5 mg. Occasionally, a higher glucose level was observed in the coronary venous than in the arterial blood. Bing[3] has observed that in the perfused fibrillating or arrested organ, in some instances, the glucose concentration in the coronary vein blood exceeded that in the arterial perfusate by more then 70 mg. per cent, but offered no explanation of this phenomenon.

The hearts (series III) which had been refrigerated and treated with vitamins, utilized approximately 5.5 mg. of glucose, 3.2 mg. of lactate, and 0.2 mg. of pyruvate; 3 of 6 hearts utilized pyruvate in a definitely improved fashion over series II (fig. 2).

It was observed that in time there occurred definite changes in the metabolism in the different hearts, usually showing reversion toward control values. This can be exemplified by the refrigerated heart which had been anoxic for 7½ hours. Initially, there was a high coronary flow of over 250 cc. per minute, which later stabilized at about 150 cc. per minute. Oxygen and carbon

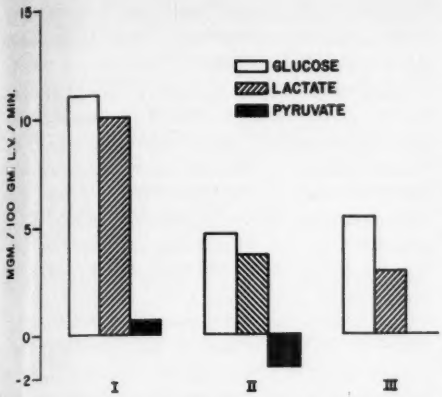

FIG. 2. Carbohydrate metabolism in transplanted hearts. *I*, immediately transplanted hearts; *II*, refrigerated hearts; *III*, refrigerated hearts with thiamin and nicotinamide.

dioxide utilization showed an early rise which later diminished to resting levels. Initially, there was a high utilization of glucose with ultimate fall to the group average. Lactate was in negative balance during the initial phase, but later showed increasing utilization up to anticipated levels. There was no utilization of pyruvate, which was true in all of the hearts in series II.

DISCUSSION

The literature of myocardial metabolism abounds with references to features which serve to differentiate myocardial from skeletal muscle metabolism.[4, 11, 12, 20, 25] Not only glucose, but also lactic acid serves as a substrate for oxidative carbohydrate metabolism of the heart. During the glycolysis (which converts glucose phosphate into pyruvic acid) each mole of glucose phosphate results in the formation of approximately 3 moles of energy rich phosphate bonds in the form of adenosine triphosphate. This represents the formation of about 33,000 calories for each mole of glucose phosphate converted into pyruvic acid. Following glycolysis in the presence of oxygen, cocarboxylase and coenzyme, pyruvic acid is then metabolized to water and carbon dioxide. During this pyruvic acid metabolism, the so-called "Krebs' cycle," approximately 33 moles of energy rich phosphate bonds can be formed, representing a total energy of about 360,000 calories. Thus, it is obvious that the energy released by oxidation of pyruvic acid is approximately 10 to 12 times as great as the energy released by glycolysis, which emphasizes the importance of oxygen, cocarboxylase, and coenzymes in carbohydrate metabolism of the heart. Under anaerobic conditions, pyruvate is metabolized to lactate, but this reaction can be reversed in the heart when oxygen is restored. Striated muscle, on the contrary, does not have this latter potential. Thus, in the absence of oxygen, cocarboxylase, or coenzymes, the glucose is metabolized by glycolysis only without pyruvic acid proceeding through the oxidation of Kreb's cycle. This anaerobic carbohydrate metabolism results in lactic acid accumulation in the tissue and the occurrence of acidosis (fig. 3) [2, 5, 6, 18, 22, 25-27]

Under normal circumstances thiamin in the phosphylated form, which is thiamin plus phosphate, known as cocarboxylase is present.[16] This is an essential enzyme for the metabolism of pyruvate in Kreb's cycle. Nicotinamide is converted to coenzymes I and II, which are necessary both for the anaerobic metabolism of pyruvate and lactate and for the aerobic metabolism of pyruvate in Kreb's cycle.

The hearts (series I) which were transplanted as promptly as possible, but which had, nonetheless, a total anoxia of 30 to 50 minutes, returned to essentially normal carbohydrate and oxygen metabolism, as compared to studies of Jesseph and co-workers.[21] In the hearts (series II) which had been refrigerated for 6 to 8 hours and subsequently transplanted, the most significant carbohydrate metabolic disturbances were the diminution of pyruvic acid utilization and the early negative balance of lactic acid. The diminution of pyruvic acid utilization in the refrigerated heart is probably due to destruction of cocarboxylase and coenzymes during the period

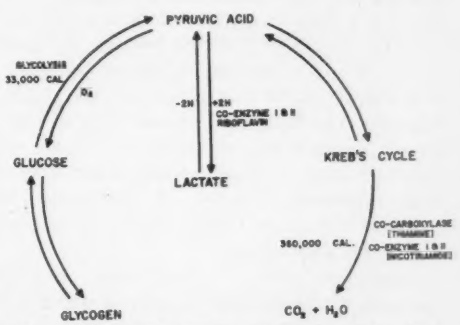

FIG. 3. Simplified illustration of carbohydrate metabolism in the heart, including Krebs' cycle.

of anoxia and refrigeration. The lactic acid probably accumulated chiefly during the period of total anoxia with some additional accumulation during the early phase of clinical function when oxygenation was only partially adequate.

Govier[13] observed in skeletal and cardiac muscles the changes of coenzyme I and cocarboxylase within 1 hour after death, and found further that coenzyme I had 25.9 per cent deterioration and cocarboxylase, 13.5 per cent. As an explanation, he suggested that after death the breakdown products of coenzymes are not removed from the tissue by the circulation and, consequently, their accumulation may serve to inhibit catabolic enzymes.

Greig and Govier[16] stated that in the tissue of dogs, after 4 hours of anoxia, cocarboxylase decreased to 49 per cent. Govier[14] found that in abnormal conditions, such as anoxia, thiamin became dephosphorylated, which reduced the amount of metabolically "active thiamin." The dephosphorylation of cocarboxylase occurred in 92 per cent of the muscles studied. Also, during anoxia the animal plasma thiamin level rises, which can be explained by diffusion of free thiamin from the tissues to the circulating plasma after cocarboxylase is dephosphorylated. Likewise, ligation of the coronary artery resulted in considerable destruction of coenzyme I.

Greig and Govier[16] stated that in the presence of hemorrhagic shock or anoxia, resynthesis of cocarboxylase occurred within 30 to 60 minutes after the administration of thiamin. Also, these authors observed that 10 per cent oxygen inhalation for 4 hours results in 49 per cent dephosphorylation of cocarboxylase. Greig[15] further stated that abnormal increases in plasma of such substances as lactate, pyruvate, phosphate, potassium, creatinine, thiamin and amino acids, have been shown to occur in shock or anoxia. Since the permeability of cells becomes increased during anoxia, various substrates normally metabolized by the cells diffuse into the plasma subtrates. The failure of pyruvate to be metabolized in anoxia is due, in the opinion of Greig, to the destruction of coenzymes and cocarboxylase. Greig observed evidence of destruction of coenzyme I in 58 per cent of the muscles studied during shock and anoxia.

Alexander[1] observed that tissue thiamin diminishes in hemorrhagic shock and stated that intravenously administered thiamin goes to the liver where it is quickly converted into cocarboxylase. It is apparent that there is destruction of these enzymes during shock or anoxia, probably due to dephosphorylation of enzymes or due to accumulation of lactic acid and resultant acidosis during glycolysis. Thiamin and nicotinamide, given intravenously, can be converted rapidly by the liver into cocarboxylase and coenzymes necessary for carbohydrate metabolism. These substances seem to restore the aerobic metabolism of pyruvic acid and, in general, improve the performance of the heart after prolonged anoxia and refrigeration.

The observation of coronary flow in the refrigerated heart shows that it has increased, from control levels of 128 cc., to 180 cc. per 100 gm. of left ventricle per minute. Bing[3] observed the opening of the previously nonvisualized capillaries in the heart following cardiac arrest.

Hilton and Eichholtz[19] observed that with less than 20 per cent oxygen saturation, the coronary flow increased up to 500 per cent. Glenn and associates[8] found marked increase in the coronary flow following hypoxia in the dog's heart, and concluded that after prolonged myocardial anoxia, there is a prolonged period of vasodilation of the coronary vessels, a matter of considerable clinical importance.

SUMMARY

1. The carbohydrate metabolism of immediately transplanted hearts shows little or no metabolic disturbance even though they were anoxic for a period of 30 to 50 minutes.

2. After periods of refrigeration ranging from 6 to 8 hours, the heart shows increased coronary flow, diminution or absence of pyruvic acid utilization, and an early negative balance of lactic acid, which improved with the passage of time.

3. Intravenous administration of thiamin and nicotinamide before restoration of coronary flow of the refrigerated heart shows definite improvement of carbohydrate metabolism and more rapid restoration of adequate cardiac function.

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EXPERIENCES IN PERIPHERAL VASCULAR SURGERY

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INTRODUCTION

For 40 years arterial surgery stood where the century's early pioneers had left it. Only by local repair was it possible to reconstruct a major artery. In 1949 Gross and colleagues[9] described the clinical application of Carrel's[2] method of homografting with the stored arteries of another individual.

The predicted widespread establishment of blood vessel banks has not become a reality because of the difficulty in obtaining the specimens, the technical problems of storage and, more important, the fact that degenerative changes occur, constituting a distinct disadvantage to their clinical use.

The demand for vascular transplants far exceeds the supply. As a result, the search for suitable arterial substances is being conducted with an intensity that approaches the phenomenal.

The pioneering efforts of Voorhees and co-workers,[14] Shumaker, Crawford and co-workers,[4] Hufnagel,[10] Edwards and Tapp,[7] and many others have led to investigation of such plastic substitutes as Vinyon-N, nylon, Dacron, Orlon, Ivalon sponge and Teflon. The development of the ideal vascular substitute will be due to the combined technical knowledge and resources of industry.

Grafting procedures are palliative. Endarterectomy is indicated only when the thrombosis or occlusive lesion is less than 10 mm. in length, providing that the arteries are soft and pliable both proximally and distally. If this situation does not obtain, then a graft is indicated.

PERSONAL CASES

As of this date our experiences in various forms of arteriovascular disease encompasses a total of 43 cases treated at the Wichita Clinic from June 21, 1956 to February 10, 1959 (table 1). The youngest of these patients was 13 years (gunshot wound of axillary artery) and the oldest 84 years (occlusive vascular disease). Occlusive vascular disease extending from the aorta to the femoral comprises the greatest number of cases, a total of 25. Aortic, iliac, femoral and popliteal aneurysms comprise 8 cases. Only 1 arteriovenous fistula located in the popliteal area (caused by a gunshot wound), necessitating resection and grafting, is included in this series.

Obstruction of the brachial artery was encountered in 3 patients; the etiology varied from gunshot wounds to automobile accidents and to embolic phenomena in the wake of auricular fibrillation. One patient was operated for thrombosis of the carotid artery at its bifurcation, producing "a stroke." One patient was subjected to bilateral subclavian arteriography because of symptoms referable to the extracranial vertebral arterial system. The patient was not subjected to surgery because we could not prove that the lesion was extracranial in origin.

Four patients were reoperated because of thrombosis occurring in the graft inserted as a femoral bypass procedure. One patient was reoperated as an emergency procedure secondary to massive hemorrhage resulting from infection. One patient was operated following a ruptured aortic aneurysm. Four of our patients have had leg amputations following bypass procedures. In retrospect we feel that amputation would have been performed sooner or later regardless, but that it was unnecessarily hastened by failure to follow the fundamental requirements of the insertion of arterial grafts.

SYNTHETIC GRAFT

The ideal synthetic graft should have the ease of handling of homograft material with even a greater guarantee of continued strength and durability. The ultimate fate of a synthetic replacement depends entirely on the integrity of the basic synthetic material and construction of the prosthesis, rather than on the tissue of the host.[6] One must consider first the thickness of the fibrin lining that is formed within the lumen of the graft itself, the rapidity of healing, flex abrasion resistance, and retention of tensile strength (fig. 3).

The stimulus for production of prosthetic grafts was brought about by various reports of the degenerative changes which have been incurred in homografts. However, there are those

TABLE 1

A. Types of vascular procedures	
Aortic resections	
Homograft	3
Edwards-Tapp graft	4
Teflon graft	3
Femoral-popliteal bypass	
Edwards-Tapp graft	12
Teflon graft	2
Femoral and popliteal resection	
Edwards-Tapp graft	1
Popliteal resections	
Edwards-Tapp graft	3
Brachial bypass	
Edwards-Tapp graft	3
Femoral embolectomy and endarterectomy	1
Popliteal embolectomy and endarterectomy	1
Carotid embolectomy and endarterectomy	1
Total	34
B. Cases operated according to pathologic lesion	
Aortic aneurysm	
Resectable	3
Nonresectable (perf. colon)	1
Aortic and ileo-femoral aneurysm	1
Aortic obstruction	
Arteriosclerotic (Leriche)	3
Invasive tumor	1
Arteriosclerotic, no distal flow, no graft	1
Occluded homograft	1
Aorto-iliac obstruction	
Arteriosclerotic	1
Femoral obstruction	
Arteriosclerotic	11
Thrombosis	1
Traumatic	1
Arteriosclerotic, no distal flow, no graft	2
Popliteal and femoral aneurysm	1
Popliteal aneurysms	2
Popliteal A-V fistula (traumatic)	1
Popliteal thrombosis	2
Brachial obstruction	
Traumatic { gunshot	1
Traumatic { car accident	1
Embolus	1
Carotid obstruction	
Embolus	1
Reoperated femoral grafts	
Thrombosis	4
Hemorrhage due to infection	1
Rupture of aorta	
Arteriosclerotic, no graft	1
Total	43

who feel that homografts are still quite satisfactory and that synthetic grafts are being produced merely as an expediency for the demand. Vein grafts, which have been used for a considerable time, have still proved successful.

It has been pointed out that crimping of the synthetic graft prevents kinking. Shortly after an endothelial lining has been laid down within the lumen of the synthetic graft, it renders it more or less a solid-like tube, and therefore crimping *per se* probably has nothing to do with flexibility.

In the process of healing of the grafts it has been shown that the fibrous tissue grows through the interstices and that a neointima forms. This new intima, when examined microscopically even months after its appearance, appears quite similar to a true intima. There is a question about the continuous process of fibrous deposition within the lumen of synthetic grafts, which ultimately could cause occlusions. This is unknown today. One of the disadvantages of synthetic grafts is that in the presence of infection they act as foreign bodies and the wound will not heal. However, these grafts will function in the presence of infection, as compared to homografts.

It has also been pointed out that homografts do develop antigenic properties. Furthermore, additional faults of homografts are as follows:

1. Arteriosclerosis does develop at the suture line, but not necessarily in the graft itself.
2. Dissecting aneurysm occurs.
3. Aneurysm of the graft itself occurs.
4. Rupture of the homograft can also occur.
5. A homograft is not resistant to infection, whereas synthetic grafts are.

Observations of aortic homografts implanted in dogs from 18 months to 4½ years revealed calcification and marked thinning grossly. Microscopically, examination revealed condensation of the graft, with complete loss of cellular elements, and a thinning of the internal and external layers which developed from the fibroblast of the recipient animal. There was marked degeneration of the elastic fibers of the homograft. The marked degree of such alteration in some of these long term grafts raised the question as to whether aneurysm might not ultimately have formed (figs. 1 and 2).

It is important to remember that in the insertion of any type of graft the fundamental process of atherosclerosis or arteriosclerosis is progressive in nature and frequently leads to a narrowing of the vessels, distal to the anastomosis, with resultant failure of the bypass or graft. Failure of

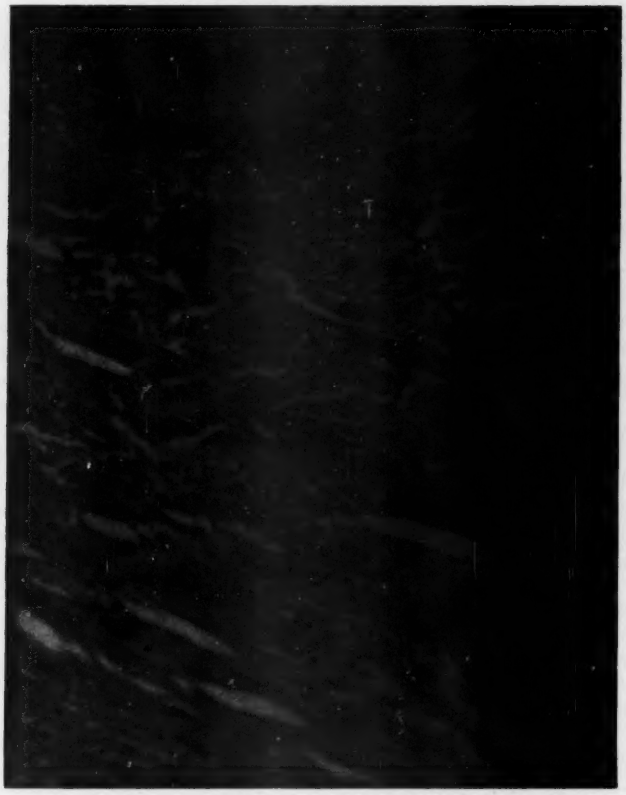

FIG. 1. Gross examination of the removed homograft disclosed advanced arteriosclerosis with extensive ulceration of the intimal lining. There were numerous zones of hemorrhage beneath the intima which had dissected through the media. A microscopic section through the wall of the remaining graft shows an unorderly attempt to organize the hemorrhage with phorocytosis of hemosiderin and proliferation of fibroblasts. In the lower portion of the section the disintegration of the media may be seen with necrosis and formation of clefts. The avascularity of the tissue is quite apparent. The small amount of viable aortic wall remaining can be seen at the lower right portion of the slide.

femoral bypass grafts is most often seen during the 1st year.

Sympathectomy is being performed less and less in all vascular work and is used perhaps as the last resort. Frequently, neuritic pains in hips and thighs follow bilateral sympathectomy. Ligation of the inferior mesenteric artery as a general rule does not produce arterial insufficiency in the left half of the colon.

COMPLICATIONS FOLLOWING GRAFTING

The most frequent complications following grafting are thrombosis, hemorrhage, sepsis of the graft and edema. Edema *per se* generally ceases to be a problem, frequently after 3 to 6 months.

With the newer grafts, such as Teflon and Dacron, thrombosis as a complication can frequently be avoided if the fundamental requirements for blood vessel grafts are remembered; namely, a good blood flow from the proximal artery and adequate distal outflow (as demonstrated by arteriography), absence of obstruction (even though not complete) distal to the site of the graft and, finally, if the vessel is not too friable or too small.

ARTERIOGRAPHY

Arteriography is essential for clinical evaluation of arteriosclerosis obliterans and aids in selecting suitable candidates for grafting. Arteriography is helpful in determining prognosis and

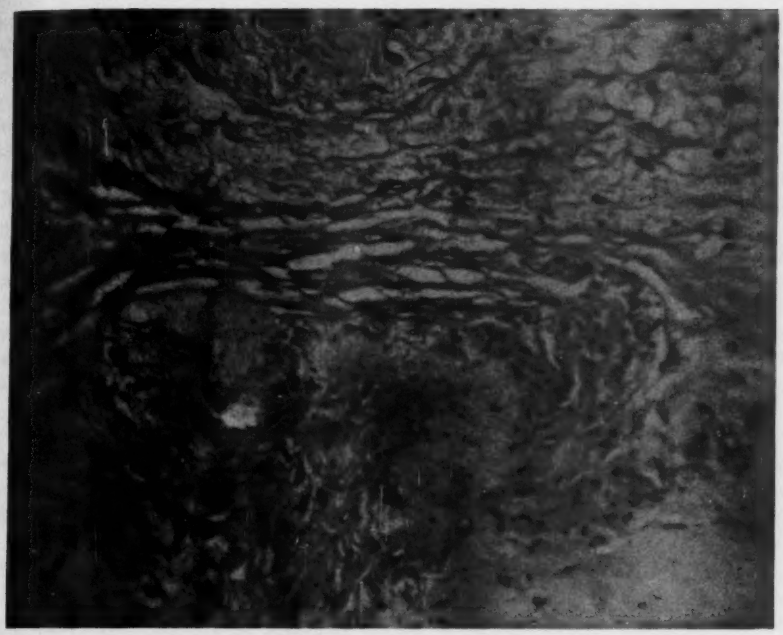

FIG. 2. Sections from other regions of the graft show more extensive fibrous replacement. The fibers in the center represent remaining portions of the graft. The lack of nuclei attests to the nonviability of the remaining fibers of the graft. The rather dense connective tissue has infiltrated the graft with separation of the remaining fibers. Organized zones of hemorrhage may be seen at left center.

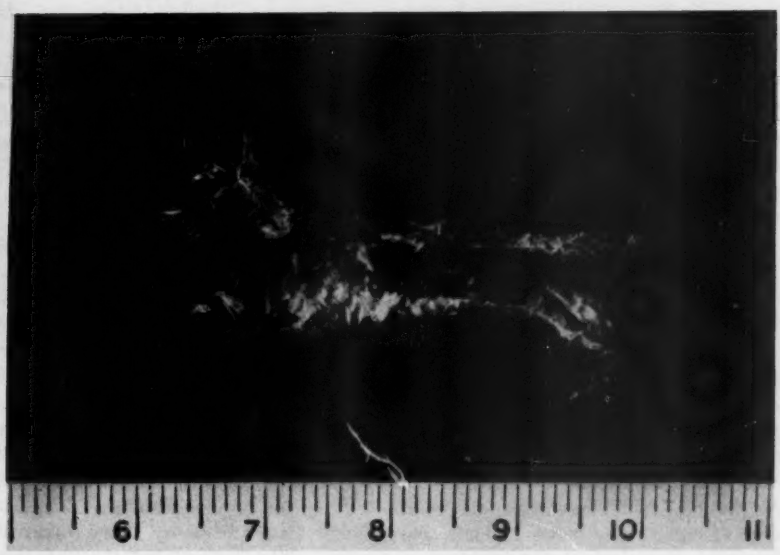

FIG. 3. Edwards-Tapp nylon graft after removal. Note the lack of connective tissue proliferation in the graft or along the inner lining. The graft is friable and easily fragmented.

is useful to indicate optimal level of amputation when necessary.

Urokon (70 per cent) is now being replaced with Hypaque solution (50 per cent) in arteriography, because of the possible complications; it is less toxic. When the needle is inserted into the aorta a small amount of dye is injected and an x-ray obtained to determine if the needle is in the correct position. Frequently 2 cc. of the dye are given intravenously to test sensitivity. Following this about 35 cc. are injected rapidly. It is wise perhaps to give 1000 cc. of 5 per cent glucose and water before arteriography to flush out the renals. An aortogram is not indicated in the presence of an aneurysm.

POPLITEAL ANEURYSMS

The diagnosis of popliteal aneurysms generally is formulated by finding an extensile pulsation in the popliteal fossa. Most commonly they are caused by arteriosclerosis, but occasionally they may be brought about by trauma. Not infrequently they involve not only the popliteal artery but may extend upward and involve the distal portion of the superficial femoral in its course through Hunter's canal. These aneurysms are sometimes seen to be bilateral. The patient complains of excruciating pain in the leg and foot due to stretching of the overlying tibial nerves. Edema of the foot and leg is caused by compression of the popliteal vein. Thrombosis and emboli are additional complications of popliteal aneurysms and finally rupture and even death occur. Diagnosis is easily confirmed by utilizing femoral arteriography. A decade ago, treatment was not altogether satisfactory. However, surgical excision and restoration of continuity of blood flow, utilizing one of the various synthetic grafts, is now quite successful.

ARTERIOVENOUS FISTULAS IN LOWER EXTREMITIES

In arteriovenous fistulas the thrill and bruit are continuous but intensified during systole. When digital closure of the artery proximal to the lesion is performed, slowing of the pulse and rise in blood pressure occurs. Lastly, there is a high oxygen content of the blood withdrawn from the veins distal to the fistula. These pertinent facts help differentiate an arteriovenous fistula from an aneurysm. Angiography will help to confirm the diagnosis.

Frequently in an arteriovenous fistula there is a traumatic scar or wound in the upper thigh. The leg and the thigh on the involved side are generally enlarged compared with the opposite. Engorged veins are easily visualized and the skin temperature is increased. The blood pressure of the leg on the involved side is always higher. Cardiac hypertrophy or dilation is a late and serious end result of untreated arteriovenous fistula. An x-ray of the involved limb reveals increased soft tissue and vascular markings. Again, we have a situation in which treatment in the past was frequently unsuccessful, but which is now amenable to surgical excision of the fistula and restoration of continuity of blood flow by utilizing synthetic grafts of one type or another.

Lastly, it is of importance from a surgical standpoint to delay surgical intervention until the newly formed fistula is well demarcated; this time interval may range from 6 weeks to 3 months.

ABDOMINAL ANEURYSMS

In general an abdominal aneurysm presents as a pulsating tumor. Frequently there is associated tenderness and a flat film of the abdomen reveals a characteristic curvilinear shell of calcification. Frequency of pain often leads to orthopedic, neurological or medical examination; the cause of pain in abdominal aneurysms may be due to vertebral erosion, nerve root compression, stretching of overlying peritoneum or rupture into the retroperitoneum. Frequently, pain caused by abdominal aneurysm mimics renal or ureteral pain. It may present in either lower quadrant. It may be limited to the low back or referred to as deep abdominal pain.

This patient is not a candidate for resection of the abdominal aneurysm if (1) there is poor renal function, (2) previous coronary disease does not contraindicate resection (but if advanced heart disease is present it does), (3) after considering the over-all vascular condition of the patient, one finds that all of the arteries are involved, *i.e.*, cerebral and so forth. If the patient has advanced cerebral arteriosclerosis and is mentally abnormal, resection probably should not be performed.

From the standpoint of resection, actually no symptoms are necessary. If the condition is present resection is warranted, if the routine contraindications for resection are not present. Frequently, rupture of the aneurysm will occur while

the patient is asleep. If the mortality of resection of an abdominal aneurysm is low, then one is justified to proceed.

Upper abdominal and lower thoracic aneurysms are relatively infrequent. In thoracic aneurysms it is best to bypass it with a graft either with or without the help of a pump oxygenator. Aneurysms of the aortic arch are either sacciform or fusiform. The sacciform aneurysm can best be resected by tangential excision. Special clamps are available for this. In the fusiform type of aneurysm the bypass procedure is used.

The commonest cause of thoracic aneurysms is lues followed by arteriosclerosis, trauma and certain indeterminate causes.

PROGNOSIS OF ABDOMINAL ANEURYSMS

A great deal of discussion has evolved relative to the prognosis of those patients with an established diagnosis of abdominal aortic aneurysm. Certain contraindications for surgical intervention have been enumerated above. There are always exceptions to the rules, and recently we had the opportunity to observe a patient who had been diagnosed 15 years earlier as having an abdominal aneurysm. Certainly this is the exception to the rule. As has been shown by numerous statistic reviews, 51 per cent of patients with abdominal aneurysms are dead in 3 years. Well over 50 per cent fail to survive more than 5 years. Death is not infrequent 6 months after the onset of symptoms caused by abdominal aneurysms. Finally, the likelihood of rupture is great.

AORTICOILIAC OCCLUSIONS AND THROMBOTIC OBLITERATIONS

These two clinical entities are closely related and have frequently been referred to as the Leriche syndrome. In aorticoiliac occlusions the causes may be listed as (1) arteriosclerosis, (2) thrombosis, (3) embolism, (4) trauma, and (5) coarctation of the abdominal aorta. The symptoms are generally progressive in character and include intermittent claudication, occasional impotence, rest pain, and gangrenous lesions of the lower extremity due to ischemia or embolism.

Aorticoiliac occlusive disease can be considered under two main headings—those under 45 and those over 45. Those cases occurring under 45 years of age appear to be more rapidly progressive in nature than those over 45. In both cases the cholesterol is apt to be elevated. Hypertension is common. Collateral circulation is better in those patients under 45.

In the true Leriche syndrome the situation is found more frequently in young male adults. Extreme liability to fatigue of both lower limbs is common. Pallor of the legs and feet is noted even when standing. Atrophy of both lower limbs is not uncommon. There is a bilateral absence of pulses in the groin and leg. Trophic changes are not present in the skin and nails. Diagnosis of this form of vascular disease is of course easily verified by aortography and the treatment of choice is resection of the involved aorta and iliac segments and replacement with a suitable graft.

OCCLUSIVE VASCULAR DISEASE OF THE LOWER EXTREMITIES

Occlusive vascular disease of the lower extremities is probably the most frequent situation requiring the use of arterial grafts in one form or another. The disease itself has frequently been treated as an orthopedic or neurological disease in the past and has been confused with arthritis of the spine or lower extremity, mechanical foot trouble, neuritic pain, Buerger's disease, or a ruptured vertebral disc. It is unfortunate that in the physical examination by the internist, orthopedist, and neurological surgeon the most common error committed is the simple failure to record the status of the peripheral pulses. Observation of the peripheral pulses, if diminished or absent, combined with arteriography will confirm the diagnosis whether it is vascular or not vascular in etiology. At present the most successful form of treatment is the bypass procedure utilizing a synthetic graft well above and below the involved segment.

VASCULAR TRAUMA

The development of arterial grafting has created a most useful function in the presence of trauma due to any cause. Automobile accidents, stab wounds, fractures and gunshot wounds frequently necessitate the introduction of a synthetic graft for preservation of life and limb. The determination of when to use a graft of one type or another is of the utmost importance. It is important to recognize what an ischemic limb looks like, and it is important to know how to feel the pedal pulses and be certain that they are either present or absent. It is helpful to determine if the patient has any sensation remaining in the limb

distal to the obstruction. This denotes serious vascular impairment. If motor function of an extremity is lost, it is mandatory to explore to determine the extent of vascular injury. Intravascular thrombosis, once it starts, extends upward and downward rather rapidly and it is important to bypass this pathologic process completely to the bifurcation above and below the area of thrombosis.

Embolic phenomena require immediate surgery. Thrombosis occurs rapidly after embolism. Even though it has been stated many times before, we think it is important to warn against the use of heat in the presence of vascular impairment. It has been shown that sympathectomy is not indicated in the problem of acute arterial injury. Heparin is helpful to prevent secondary thrombosis.

CEREBRAL ARTERIAL INSUFFICIENCY

It appears that the usefulness and the indications of arterial grafting are now beginning to extend into the field of cerebral arterial insufficiency. Pathologic involvement of the carotid and vertebral systems which are extracranial is now being subjected to closer scrutiny and surgical intervention.[5] It is estimated that 25 per cent of patients with strokes have lesions that are extracranial. With the realization that thrombosis follows rapidly in the wake of embolism and that thrombosis also spreads rapidly following occlusion, it would appear that every attempt for early and accurate diagnosis of a possible extracranial lesion be performed rapidly after the onset of symptoms if successful surgical intervention can be carried out.

SUMMARY

At the present time peripheral vascular surgery is a well defined field of surgical endeavor, having wider vistas than ever before. The future is limited only by the imagination and to the fundamental investigations of industry and science at large.

The selection of cases for various types of peripheral vascular surgery will probably be made with greater care in the future, since the initial enthusiasm for this new field of surgery is becoming a part of everyday surgery.

The ophthalmologist, it would appear, can be of more than considerable help in determining if the fundamental disease process tends to be segmental or diffuse in character.

In the consideration of performing peripheral vascular surgery in the wide field of occlusive disease, the patient commonly has signs and symptoms of coronary artery disease. We believe that the EKG itself is not sufficient to quantitatively evaluate the extent of coronary disease; this evaluation should probably be placed in the hands of a competent internist.

Arteriographic evidence of occlusive peripheral vascular disease should not in itself constitute an indication for surgical intervention, but should be weighed equally with regard to the patient's symptoms.

No matter how severe or extensive the disease process is, a total evaluation of the individual patient with particular emphasis on his own desires should be considered before surgery is offered or advised.

However, to counterbalance this expression of enthusiasm I hasten to quote Dr. Hines of the Mayo Clinic, who allegorically summarized the present status of peripheral vascular surgery somewhat as follows: "You can make a silk purse out of a sow's ear, but not infrequently the silk purse will revert to a sow's ear at the stroke of midnight!"

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METASTATIC CARCINOMA OF THE PROSTATE: RESPONSE TO RADIOACTIVE PHOSPHORUS (P^{32}). A CASE REPORT

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Dallas, Texas

The two most distressing features of advanced, inoperable carcinoma of the prostate are urinary difficulty and distress, and metastatic bone pain. The first can, in most instances, be relieved by suprapubic cystostomy or by transurethral prostatic resection, if hormonal control by castration and/or the use of estrogens is not entirely satisfactory. The crippling pain of bony metastases which recurs and persists, despite attempted hormonal control, may at times be benefited by deep x-ray therapy or by bilateral adrenalectomy. Recently we have shown[3] that many patients have been rehabilitated following the use of testosterone and radioactive phosphorus when all other methods have failed. Many of our patients who have been receiving narcotics at frequent intervals stop asking for them (unless they have already become addicts) after the third or fourth dose of radioactive phosphorus. Osteolytic lesions become osteoplastic and the sclerotic fill-in, in due time, is reabsorbed leaving normal bony architecture.

These changes have all been seen and experienced following orchiectomy and the use of estrogens. Although we felt that the radioactive phosphorus produced similar changes, we had no visible proof, for most of our patients had already had attempts at hormonal control of their carcinoma before they were given testosterone and radioactive phosphorus.

CASE REPORT

Dr. J. B. S. Maxfield and Dr. J. R. Maxfield, Jr.

B. C., a Negro man aged 55, was referred to me for consultation and treatment for carcinoma of the prostate, on September 10, 1957. He gave a history of some mild urinary difficulty, but his chief complaint was of a persistent, nagging backache radiating down both hips which prevented his working in the daytime and became so severe at night that he could not sleep. On physical examination the only abnormal finding was a very large, irregularly nodular, stony hard prostate. Excretion urograms revealed normal upper urinary tracts with a normal bladder with slight elevation of the base suggesting some enlargement of the prostate. A postvoiding film showed a minimal amount of residual urine. The K.U.B. demonstrated ". . . some sclerosis of the body of L1 and to a lesser degree of L3 and L4. There is also some sclerotic reaction in the upper sacrum and several relatively discrete lesions in the ischium. These findings are suggestive of metastatic involvement from a carcinoma of the prostate."

The patient was advised to have a bilateral orchiectomy, and estrogens were prescribed. He refused both because it would interfere with his "manhood." He was then advised that a course of testosterone and P^{32} would relieve him of his pain but should make no change in his urinary difficulty, and would not in any way interfere with his "manhood." He accepted this advice.

On September 13, 1957, after consultation with radiology consultants, he was given 100 mg. of testosterone intramuscularly. This was repeated daily, except for 2 days (Saturday and Sunday) until and including September 26, 1957. On September 16, 1957, he was given 1500 μc. of radioactive phosphorus intravenously. The same dosage was repeated on September 17, 18, 19, 20, 23, 24 and 25. He thus received 12,000 μc. in all. His backache was completely relieved after the third dose of radioactive phosphorus.

At the beginning of his treatment his hemoglobin was 13.4 gm. and his hematocrit 42. The W.B.C. count was 8.7 thousand. At the end of his treatment the hemoglobin was 13.3 gm.; hematocrit, 40; W.B.C. count, 8.2 thousand. At the onset of treatment his acid phosphatase was 18.00 Guttman and Guttman units, and the alkaline phosphatase was 80 King and Armstrong units.

Toward the end of January 1958 the patient was again having some pain and a radiographic bone survey showed ". . . multiple lesions of increased density throughout the skull. The cervical spine showed multiple areas of marked increase in density. Areas of density also extended down through the dorsal and lumbar spine. There was a generalized increase in density throughout all the bony structures of a very marked and diffuse osteoplastic type. This involved the shafts of the humerus on both the right and the left sides, the ribs, the clavicles, the scapulae, the bony structure

of the pelvis and the upper portions of both femurs."

When compared with his previous radiographs, the radiographic appearance of his generalized bony metastases now was dense and sclerotic as if he had been castrated. The prostate however was somewhat larger and harder, but his urinary symptoms were still minimal.

By February 1958 he was once more beginning to have some pain. His hemoglobin had fallen to 7.4 gm.; the hematocrit to 23; the W.B.C. count to 7.5 thousand. The acid phosphatase was 14.3 Guttman and Guttman units and the alkaline phosphatase was over 50 King and Armstrong units. He was given another 1500 μc. of radioactive phosphorus on February 7, 8 and 16, which once again relieved him of his discomfort.

His hemoglobin for the next 5 months remained relatively unchanged, varying between 7.5 and 8.6 gm.; whereas the hematocrit varied between 25 and 35; and the W.B.C. count, between 4.5 and 6.5 thousand.

In August 1958, about 1 year after he was first seen, he was once more beginning to have some pain. He was finally persuaded that this was likely to continue and recur until one could control the source of his metastases. He consented, after much persuasion, to have a bilateral orchiectomy. This was done August 18, 1958, and at this time another metastatic bone survey was made. This showed even further advanced sclerotic changes in practically every bone of his body as well as some new osteolytic areas. At the time of surgery his hemoglobin was 8.2 gm.; hematocrit, 24. This was promptly raised to a hemoglobin of 10.2 gm.; hematocrit of 32, by one transfusion of 500 cc. of blood. His serum acid phosphatase was 10.4 Guttman and Guttman units and his alkaline phosphatase over 50 King and Armstrong units. Following surgery the acid phosphatase rose to 17.5 and 18.5 Guttman and Guttman units and the alkaline phosphatase remained over 50 King and Armstrong units. He recovered promptly from his operation and was put on estrogen therapy. His pain once more completely disappeared. At present he is up and about and has no urinary difficulties, although he is weak and feels tired and has lost considerable weight.

This case report indicates that radioactive phosphorus is picked up and stored by the body tissues in the presence of carcinoma of the prostate in the same way that it is in carcinoma of the breast,[1] and that the concentration of radioactive phosphorus in bony metastases, as Hertz[2] showed in 1950, is ever so much more in the bony metastases than in the soft tissues, as for example the prostate. This patient's prostate showed no regressive change whatsoever following the treatment with radioactive phosphorus, but his bony metastases responded to radioactive phosphorus in the same way that they usually do following castration. The very extensive bony metastases involving almost every bone in his body can very readily account for his continued anemia.

This case report confirms our previous observations[3] and proves very positively that radioactive phosphorus can be of benefit in the management of advanced metastatic carcinoma of the prostate.

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FURTHER OBSERVATIONS ON THE USE OF MARLEX MESH: A NEW TECHNIQUE FOR THE REPAIR OF INGUINAL HERNIAS*

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Marlex mesh, which has proved to be quite inert and resistant to infection, has met almost all of the criteria necessary to a prosthesis for hernia repair.[1-3] Because of its excellent flexibility and resistance to fragmentation due to work fatigue, it has a decided advantage over tantalum mesh. Its soft texture permits its use in an intraperitoneal position, adjacent to intestines and omentum, without fear of penetration of viscera by its fibers.

The use of the mesh as an intraabdominal support in the repair of incisional hernias and other tissue defects of the abdominal wall by this intraperitoneal technique has continued to be most successful.[4] This type of repair is more physiologic than the more conventional "onlay" technique in that the prosthesis is in a position of greater mechanical advantage, comparable to the principle of a boot in an automobile tire. Being adjacent to the highly vascular omentum, fibroblasts quickly penetrate the porous mesh and fibrous tissue is generated much faster than is the case when it is placed over relatively avascular fascia or peritoneum. It is for this reason that we purposely excise peritoneum in the intraperitoneal repair of incisional hernias and allow the omentum to come in direct contact with the mesh. Such adhesions of bowel to mesh as do form apparently do no more harm than those present following any laparotomy. In over 40 dogs in which the Marlex mesh was placed adjacent to bowel (in some dogs the omentum was purposely excised), there were none in which intestinal obstruction or penetration of bowel by the fibers of the mesh took place. If care is taken to spread the omentum evenly under the mesh, very few, if any, bowel adhesions will form.

The successful use of the Marlex mesh for the repair of incisional hernias[1] by the intraperitoneal method prompted us to try a similar technique for the repair of inguinal hernias. The usual method of using tantalum mesh or other "patch" prostheses has been to use them as an onlay graft after some type of reconstruction of the inguinal floor. As a rule, tension is created by either the repair under the prosthesis or by the prosthesis itself, unless a relaxing incision is made in the anterior rectus sheath. We have seen suprapubic hernias result from the use of this type of relaxing incision.

We found that by suturing the Marlex mesh in a subfascial position beneath transversalis fascia and conjoined tendon, a suitable replacement for the inguinal floor could be obtained without tension and without the need of relaxing incisions.

The technique we have employed is as follows:

After ligation and excision of the hernial sac, the transversalis fascia in the floor of the canal is incised from the pubic tubercle to the internal ring. The epigastric vessels are ligated and di-

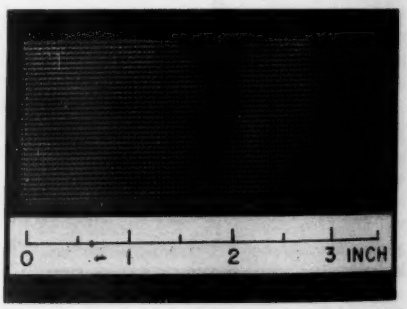

FIG. 1. Marlex mesh graft for inguinal hernia repair.

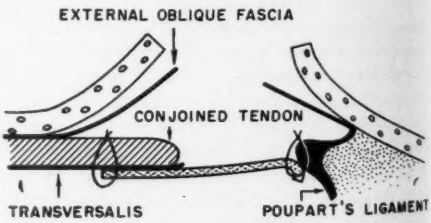

FIG. 2. Subfascial technique of inguinal hernia repair, showing method of suturing the graft to the under surface of the transversalis fascia and conjoined tendon.

* From the Cora and Webb Mading Department of Surgery, Baylor University College of Medicine.

vided unless they can be easily separated by blunt dissection from the transversalis fascia. Ochsner forceps are placed on the upper margin of the transversalis fascia, it is elevated and the retroperitoneal fat is swept from its under surface by blunt dissection. A piece of Marlex mesh measuring 3½ by 1½ inches is then sutured to the under surface of the transversalis fascia by means of through-and-through mattress sutures of No. 00 black silk placed approximately ½ inch above the free edge of the conjoined tendon. About 6 to 8 such sutures are placed, extending from the

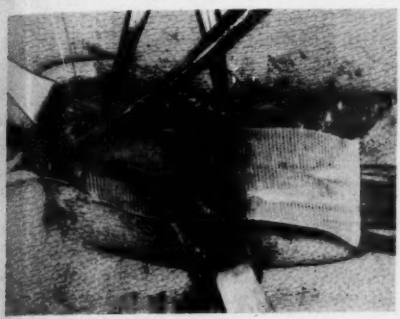

FIG. 3. Subfascial repair of a left inguinal hernia. The first mattress suture has been placed through the conjoined tendon.

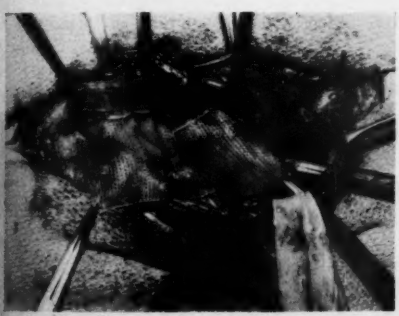

FIG. 4. The upper row of mattress sutures has been completed and the lateral edge of the graft folded to form a cuff for the emergence of the cord.

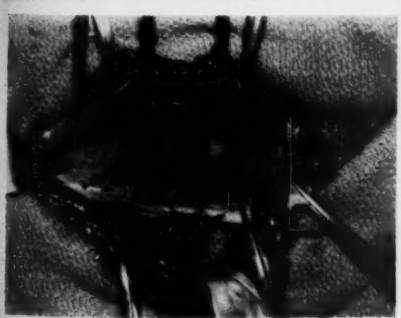

FIG. 5. The lower edge of the graft has been folded in and sutured to Poupart's ligament. Black dots indicate sutures.

FIG. 6. The repair of the inguinal floor has been completed.

FIG. 7. The cord is replaced in its normal position on the reconstructed inguinal floor.

FIG. 8. The external oblique aponeurosis has been closed over the cord.

TABLE 1

Summary of patients with inguinal hernias repaired by the subfascial technique

Case	Age	Sex	Date of Operation	Type of Hernia	Operation
1	47	M	9- 8-58	Left direct	Ligation of sac and subfascial repair with Marlex mesh
2	59	M	9-22-58	Left indirect (large)	Ligation of sac and subfascial repair with Marlex mesh
3	77	M	10-14-58	Left indirect-direct	Ligation of sac and subfascial repair with Marlex mesh
4	45	M	11-11-58	Right indirect, sliding, recurrent	Intraabdominal repair of sac and subfascial repair with Marlex mesh
5	58	M	11-17-58	Bilateral direct	Imbrication of sacs and subfascial repair with Marlex mesh
6	57	M	11-29-58	Left indirect, sliding	Intraabdominal repair of sac and subfascial repair with Marlex mesh
7	68	M	1-14-59	Left indirect, sliding	Intraabdominal repair of sac and subfascial repair with Marlex mesh
8	56	M	1-19-59	Left indirect, sliding, recurrent	Intraabdominal repair of sac and subfascial repair with Marlex mesh
9	48	F	1-20-59	Bilateral direct, recurrent on left	Imbrication of sacs and subfascial repair with Marlex mesh
10	71	M	1-22-59	Right indirect-direct	Ligation of sac and subfascial repair with Marlex mesh
11	48	M	1-29-59	Right indirect, recurrent	Ligation of sac and subfascial repair with Marlex mesh
12	63	F	2- 5-59	Right direct, recurrent	Imbrication of sac and subfascial repair with Marlex mesh
13	52	M	2-17-59	Right direct	Imbrication of sac and subfascial repair with Marlex mesh

pubic tubercle to a point approximately ½ inch lateral to the internal ring. After these sutures have been placed and tied, the lower margin of the mesh is pulled down to Poupart's ligament and the free edge turned under in such a manner that a firm, snug floor will be created when sutured to this structure. After suturing the folded edge of the mesh to Poupart's ligament, 3 or 4 through-and-through mattress sutures are placed lateral to the internal ring, folding the lateral border of the mesh so as to create a narrow cuff for the exit of the cord. It is not necessary or desirable to cut a slot in the mesh for emergence of the cord. By careful folding of the mesh, and by proper placing of the lateral sutures, a new internal ring is created which allows the cord to emerge in a normal, oblique direction.

The repair of the inguinal floor is thus completed. No attempt is made to suture the free edge of the transversalis fascia or conjoined tendon over the mesh, since to do so would create tension and nullify the purpose of the graft, *i.e.*, to provide a firm replacement without undue tension. The cord is allowed to rest on the newly created inguinal floor and the external oblique aponeurosis closed over it, as in a Bassini repair. Drainage of these wounds is unnecessary; we have encountered no wound complications.

We know from our experimental studies that the mesh will become well infiltrated with pliable fibrous tissue and serve as a good replacement for the attenuated transversalis fascia.

The postoperative course of these patients has been remarkable. They are quite free of postoperative pain (usually only one or two administrations of an analgesic are necessary during their hospitalization), catheterization is seldom necessary, and they are able to walk in an erect position without incisional pain or discomfort. Apparently, this freedom from wound pain is a result of the

relaxation of the inguinal structures afforded by the use of the graft.

We have used the subfascial technique only on direct hernias, the direct-indirect (saddlebag) hernias, and on recurrent hernias (table 1). We believe that the majority of indirect hernias can be repaired without the need of a prosthesis. Where a true deficiency of the inguinal floor exists, we believe this type of repair will prove to be most effective.

Since September 1958 we have repaired 13 inguinal hernias by this technique. There have been no recurrences and no wound infections.

SUMMARY

A new technique using Marlex mesh has been described for the repair of inguinal hernias. It has the unique advantage of creating a firm replacement of the inguinal floor without tension.

The results in 13 hernias repaired by this method have been most encouraging. We believe this technique of repair will prove to be of value n the repair of direct inguinal hernias and others in which a weakness of the transversalis fascia is present.

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ADDENDUM

Since March 1959, 10 additional patients have been operated upon without recurrence and without wound complications.

THE USE OF CITRATED BLOOD IN EXTRACORPOREAL CIRCULATION*

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The purpose of this series was to attempt to utilize citrate blood in extracorporeal circulation. Extracorporeal apparatuses utilized to effect this circulation have come into prominence during the past decade. Stored blood or citrate preserved blood has been banned from use during these operations because of previous difficulty with cardiac asystole and arrhythmia. If it were possible to utilize bank or stored blood for these procedures the donor problem would be greatly simplified.

In 1943 Ivy and co-workers[11] investigated the toxicity of citrated blood and found that blood containing 0.25 per cent sodium citrate, if given fast enough, could cause death in the dog. Modern citrate blood is approximately 0.4 per cent citrate in the form of sodium salt. It was stated that transfusions of such blood in excess of three to five bottles to a 70-kg. man might cause death. At the Southwestern Surgical Congress in March 1958, Dixon[5] presented a paper referable to citrate and hemorrhage. During the course of his discussion he stated that the total *serum* calcium is approximately one-half diffusible calcium, and one-half protein bound calcium which is nondiffusible. Two-fifths of the diffusible calcium is ionized. The citrate in the machine blood mobilizes calcium from the skeleton, increasing the total serum calcium, but at the same time combines with the ionized fraction, reducing it to levels at which tetany and asystole occur. Citrate poisoning is not often accompanied by bleeding, since the amount of free calcium required for blood clotting is much less than the amount required to contract the heart and relax the skeletal muscle. It is difficult to utilize heparinized blood in extracorporeal circulation. Abbott and associates[1] have developed a solution, which will extend the time during which heparinized blood may be used, from 7 to 24 hours. At the present time, most workers in the field of extracorporeal circulation must draw blood for priming the machine in the late afternoon of the day before surgery, or early in the morning of the day of surgery. Blood from a bank cannot be used because of the toxicity of citrate. With this problem in mind an effort was made to find some way to utilize the routine stored blood in extracorporeal circulation.

* Sponsored by the Sedgwick County Heart Association, the Midwest Medical Research Foundation, St. Francis Hospital, and the Wichita Clinic, Wichita, Kansas.

HISTORY

Citrate has been blamed for clotting difficulties following massive transfusions. This is understandable if almost all of the ionizable calcium, a small amount of which is necessary for blood clotting, is replaced or neutralized. Krevans and Jackson[12] studied 32 patients who received whole blood transfusions. They noted a definite thrombocytopenia and, in 11 instances, abnormal bleeding. The thrombocytopenia was related to the amount of whole blood transfused and the rate of infusion.

Allen and associates[2] studied patients who had massive transfusions and/or plasma therapy. The toxic effects of the citrate were attributed primarily to the immobilization of ionizable calcium. The amount of citrate could be greatly increased if ionizable calcium was given either intermittently or continuously throughout the course of massive citrate blood transfusion. Although the authors had not observed untoward effects with citrate transfusions in man, it was postulated if such did occur, the intravenous administration of ionizable calcium salts would exert a beneficial effect.

Ivy[11] found that large amounts of citrate blood or plasma were toxic. He recommended caution when quantities of more than 1200 cc. of blood were utilized in patients who had lost from 40 to 50 per cent of their circulating blood volume. Heparinized plasma was found to be safer than citrated whole blood or plasma. Firt and Hejhal[6, 7] discovered that citrate in large amounts produced constriction of the pulmonary vascular bed and depressed myocardial activity. The effect

of citrate during transfusion could be safely counteracted by the simultaneous intravenous administration of ionizable calcium and procaine.

EXPERIMENTS

With the work of Firt and Hejhal[6, 7] in mind, attempts were made to use old citrate blood in extracorporeal circulation. Firt and Hejhal[7] utilized 25 cc. of 10 per cent calcium gluconate in the first 500 cc. of citrate blood, and 10 cc. for each succeeding bottle. The above method for utilizing calcium gluconate has resolved itself into a simple 55 cc. of calcium gluconate per 2000 cc. of blood. Stored citrate blood at least 1 week old was utilized throughout the course of the experiments. It was thought that old blood would contain few platelets and, therefore, bleeding tendencies would be counteracted solely on the basis of the calcium and citrate, heparin and protamine relationships.

Nakasone and associates[13] found that when citrate blood was circulated rapidly the electrocardiographic changes were directly related to the amount of citrate. These changes could be avoided by the use of hypocalcemic blood.

Tetany has been abolished during exchange transfusion in newborn infants by the administration of calcium gluconate.

In view of the above, 18 dogs were subjected, under clinical conditions, to extracorporeal circulation (table 1). In all instances either the auricle or the ventricle was opened in conjunction with other experiments. There were 7 survivors in linear fashion accomplished. Number 8 was a failure due to anoxia and mechanical difficulty with the input catheter. Numbers 9 and 10 were failures because of blood clotting in the machine. Because of the above three failures it became apparent that *the heparin must be added to the machine blood before the calcium.*

Following the three failures, 8 more dogs were run in consecutive fashion; all survived. It is pointed out that this is a consecutive series with no exclusions. The oxygenator used was of the rotating disk type. The pumping mechanisms were those devised by Sigmamotor. In no instance was cardiac arrest instituted during the extracorporeal circulation run. The exact method was as follows:

1. The extracorporeal circulation machine was primed with 2000 cc. of old citrate blood (A.C.D. solution) which was at least 1 week old.

2. During the priming of the machine, to the machine blood is first added heparin in the amount of 72 mg. per 2000 cc. of blood (the heparin is later neutralized milligram per milli

TABLE 1

Number	Date	Procedure	Length of Run	Result	Cause of Death
			min.		
1	11- 5-58	Auriculotomy	18	S*	
2	11-12-58	Auriculotomy	14	S	
3	11-19-58	Auriculotomy	16	S	
4	11-26-58	Auriculotomy	20	S	
5	12- 3-58	Auriculotomy	20	S	
6	12-10-58	Auriculotomy	12	S	
7	12-17-58	Auriculotomy	18	S	
8	1- 7-59	Auriculotomy	12	Died	Mechanical, anoxia
9	1-14-59	Auriculotomy	8	Died	Clotted blood
			6		
10	1-21-59	Auriculotomy	10	Died	Clotted blood
11	1-28-59	Auriculotomy	18	S	
12	2- 4-59	Auriculotomy	18	S	
13	2-11-59	Auriculotomy	14	S	
14	2-18-59	Ventriculotomy	20	S	
15	2-25-59	Auriculotomy	18	S	
16	3- 4-59	Auriculotomy	60	S	
17	3-11-59	Auriculotomy	20	S	
18	3-18-59	Ventriculotomy	18	S	

* S = "survivor" patient dog: see text for details.

gram with protamine). After heparin has been mixed with the machine blood, 10 per cent calcium gluconate is added in the amount of 55 cc. per 2000 cc. of machine blood.

3. Just before the run 3.5 mg. of heparin per kilogram of body weight is added to the patient.

4. After the run heparin is neutralized milligram per milligram with protamine.

A "survivor" patient dog is categorized as one which wakes up, breathes on his own, has a good blood pressure, and shows no sign of circulatory collapse at the completion of the procedure. The dog also must live past the operative period and be returned to the cage.

DISCUSSION

In 1943 Hill and Muirhead,[8] in a discussion of citrate reactions during animal experimentation, stated that these reactions were extremely rare and that the response was due to a binding of calcium by an excess of sodium citrate in the anticoagulant solution. The symptoms in a fully developed reaction were described as: generalized tingling sensations, apprehension, dilation of the pupils, carpopedal spasm and tetany; Chvostek's sign positive, and generalized rigidity. It was felt that this type of reaction was related to three factors: (1) the addition of citrate to the donor blood, (2) the rapid injection of the blood, and (3) the low blood calcium of infants and hypocalcemic adults. The authors also mentioned that the speed of reaction was essentially the cause of the trouble, since citrate is very rapidly oxidized after entering the blood stream. Reactions occur when sodium citrate is introduced into the blood stream with sufficient rapidity to exceed the capacity of the oxidation mechanism. This changes the recipient's calcium in the ionized state to an unionized form and calcium deficiency develops.

In 1956, Hubbard and associates[10] observed severe citrate intoxication during transfusion. This was believed to be due to a fall in ionized calcium and was associated with prolonged QT intervals and elongation of the ST segment in the electrocardiograph tracing. The consequent hypotension did not respond to further transfusions and was thought to progress to cardiac arrest. Under anesthesia the electrocardiograph was found to be the best indication of citrate intoxication. Bunker and associates[3] have stated that citrate is excreted in the urine and metabolized in the muscle and liver. Patients with liver disease have poor tolerance to citrate, as evidenced by higher serum citrate and lower ionized calcium levels. Howland and associates[9] have stated that the physiologic effect of massive blood transfusions falls into two main categories: (1) a hemorrhagic tendency, and (2) cardiac malfunction in the form of asystole or ventricular fibrillation. It was thought by Howland and associates[9] that citrate intoxication played an important role in the development of cardiac asystole and ventricular fibrillation during massive blood replacement. Cookson and associates[4] felt that induced hypothermia probably compounded the danger of citrate intoxication. The reason was thought to be that the rate of citrate metabolization was depressed along with the other metabolic processes at the lower temperature.

During past years the theories advanced to explain the mechanism of blood clotting have been increasingly complicated. This discussion will not attempt to portray a new or different theory of blood clotting. A hemorrhagic tendency may be attributed to any one of several factors. Platelets have assumed an increasingly significant role. The exhaustion and disappearance of platelets in stored blood is well known. There are new agents, such as serotonin, and many other new elements in the mechanism of blood clotting. An agent has been discussed which is necessary to the action of thromboplastin. There are some authors who feel that the firmness of the clot is effected by an unknown agent.

Anoxia is thought to catalyze clot destruction; therefore, a poorly oxygenated patient during extracorporeal circulation would tend to have a bleeding tendency on this basis alone. The loss of ionizable calcium, if severe enough, can cause a hemorrhagic tendency. However, the amount of calcium necessary for the blood clotting mechanism to operate is very small, when related to the amount of calcium necessary for adequate cardiac contraction.

The exact mechanism of cardiac standstill or arrhythmia produced by rapid transfusion or replacement of the major portion of the blood volume with citrated blood is still in doubt. The action of the potassium and calcium ions on the heart leads one to conclude that an excess of one or the other, in the face of citrate intoxication, may result in cardiac standstill or arrhythmia.

Experiments in dogs demonstrated that a too

rapid administration of citrate blood caused "a cardiac overloading."[6, 7] The cardiac failure depends not upon the amount of blood *in toto*, but rather upon the toxicity of the citrate and the condition of the myocardium. The same amount of blood under similar circumstances, utilizing heparin as an anticoagulant, did not result in the cardiac overloading syndrome or cardiac arrhythmia. Firt[7] also demonstrated that citrated blood could be given without signs of cardiac overloading at rates 50 times greater than hitherto used, if citrate and gluconate were given simultaneously.

Bunker and associates[3] studied the serum citrate, calcium, total protein, magnesium, and potassium levels in 130 patients during transfusion of citrate blood. In most of the patients studied it was not possible to implicate the elevated citrate level as solely or even partially responsible for hypotension or difficulty in blood coagulation. The clinical situation was thought to be a complex one. In many of the patients there were marked elevations in the serum citrate level which was thought to be sufficient to depress the ionizable calcium. High concentrations of serum citrate were observed during multiple transfusions in all patients with or without liver disease, and during extremely rapid or prolonged infusions of citrate blood. Intravenously administered calcium salts were not found to be very satisfactory in the treatment of patients with clinical citrate intoxication.[3]

Cookson and associates[4] postulated that the deleterious effects produced by citrate are due to the removal of the ionized calcium from the blood stream with a resultant impairment of cardiac contraction. Howland and associates[9] noted, on several occasions, changes in the electrocardiograph suggesting impending cardiac difficulty. These were improved by an injection of calcium gluconate. This was suggestive evidence that citrate intoxication or hypocalcemia may play an important role in the production of cardiac malfunction after massive transfusion. Laboratory evidence at the time of Howland's discussion was not sufficient to justify a more definite statement. Nakasone and associates,[13] during the course of artificial kidney experiments, noted derangements of the circulatory function. The alterations were thought to be due to the citrate hypocalcemia induced by the sudden infusion of large volumes of A.C.D. treated blood. Electrocardiographic changes occurred at the equivalent cumulative citrate doses. Blood rendered hypocalcemic by passage across a cation exchange did not produce similar circulatory derangement, in spite of the exchange of enormous amounts of blood. Serial analysis of serum calcium levels during the course of massive exchange transfusion demonstrated that a nearly normal concentration could be maintained. This suggested that rapid mobilization of calcium could be effected by the body reservoir.

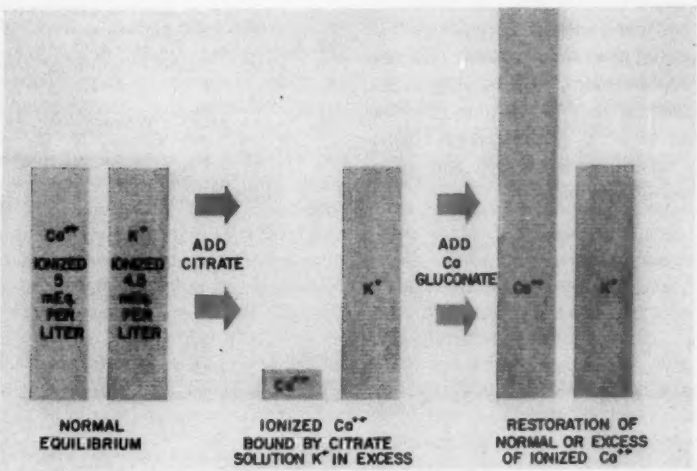

FIG. 1

SUMMARY

In extracorporeal circulation, using old citrate blood, the onset of "the run" presents to the patient more citrate than the recipient can oxidize or metabolize. This binds the available ionizable calcium and results in a relative excess of potassium.

It has long been known that an injection of potassium citrate, given rapidly into the coronary circulation, will cause cardiac arrest in diastole. If the potassium citrate is given slowly it will cause auricular and ventricular fibrillation and/or other irregularities.

"Going on the run" utilizing citrate blood in the extracorporeal apparatus has the same effect as the sudden injection of potassium citrate; it binds the calcium in a nonionizable form.

Supplying ionizable calcium at the same time as the presentation to the recipient of an excess of citrate blood results in a relative excess of potassium *balanced by* a relative excess of calcium, and no cardiac irregularities result (fig. 1).

1. A method utilizing old citrate blood (A.C.D. solution) in extracorporeal circulation is described.

2. A series of dogs, under clinical conditions, has survived the extracorporeal run with this method.

3. The possibility that potassium and calcium enjoy a reciprocal relationship in the blood stream is suggested: a sudden increase of circulating citrate solution binds ionizable calcium and causes a relative increase in potassium. This relative increase in potassium may cause arrhythmia.

4. In the future it may be possible to utilize citrate or bank blood in extracorporeal circulation. Further experimental research and refinement of method are necessary.

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CHOLECYSTECTOMY: A CRITICAL ANALYSIS OF A PERSONAL SERIES

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Cholecystectomy affords remarkable relief to those patients whose primary difficulty is that of cholecystitis. However, the patient is subject to difficulties after cholecystectomy from one of three types of error on the part of the surgeon. The first is error in the preoperative evaluation of the symptoms of the patient. The second is in errors of omission at the time of surgery. The third is in errors of commission at the time of surgery.

It is the purpose of this paper to review a series of cases, with particular emphasis on those patients who did not experience complete relief from surgery. A brief statistic analysis is presented in order to place these patients in the proper perspective with regard to the entire group of cholecystectomies.

The cases presented are those which were personally operated by the author from May 1952 through November 1958. Only those instances in which cholecystectomy was performed are included. Most of these cases were operated in one hospital, but the entire series covers operations performed in five different hospitals in Huntsville and three surrounding communities. The pathologic diagnoses were those reported by qualified pathologists serving these hospitals at the time the specimens were removed. The follow-up reports were obtained in most instances from the patient or his family, by answer to an interrogation mailed to the patient. In other instances, the follow-up was obtained either by personal communication or by communication with the patient's family doctor in those instances in which he had seen the patient since surgery and definitely remembered the patient and whether or not he had remained asymptomatic. Others were classified as being lost to follow-up. The total number of cases presented here is 148. The sex incidence may be seen in table 1.

The age incidence may be seen in table 2. The largest incidence occurred between 40 and 59 years of age. Two of the youngest patients were 18; 1 of these was a boy who had had a cholecystostomy elsewhere for acute obstructed cholecystitis 1 year previously, with a persistent mucous fistula. The oldest patient was 76 years of age.

There were 2 deaths out of 148 cases, an operative mortality rate of 1.35 per cent. The first was a 57-year-old white woman who had been operated on in 1952 for chronic cholecystitis and cholelithiasis. In the postoperative period she progressed satisfactorily, and was afebrile and ambulatory from the 1st postoperative day until discharge on the 7th postoperative day. She returned home, entertained visitors throughout a good part of the day, and retired in her usual fashion. During the night she died in her sleep, due to unknown causes but most probably the result of pulmonary embolism.

The second death occurred in a 59-year-old white woman. This patient had been explored and an acutely inflamed gall bladder had been found; the author was called in to remove the gall bladder. Her blood pressure remained low for about 48 hours, despite adequate blood transfusion, but gradually returned to normal levels and remained normal for 6 days. On the 6th postoperative day she seemed to be in satisfactory condition on morning rounds, but died suddenly during the early evening. We were unable to adequately explain the death of this patient, especially since postmortem examination was not granted. If there were errors on either of these patients, we are unaware of their type.

The pathologic findings in all the cases are listed in table 3. In 146 cases (98.7 per cent) there were definite pathologic findings. No disease was reported in 2 cases. In 1 of these 2 instances a 46-year-old white woman presented with symptoms resembling those of chronic cholecystitis. Two preoperative cholecystograms had revealed a nonfunctioning gall bladder. These examinations were done 3 days apart, with no history of vomiting the dye after swallowing it. Accordingly, this patient was explored. The gall bladder appeared relatively normal; however, it has been our experience that in many instances small stones cannot be palpated. Therefore, the gall

Presented before the Southeastern Surgical Congress, Deauville Hotel, Miami Beach, March 9 to 12, 1959.

TABLE 1

Sex	No. of Cases	Per Cent of Total
Females	116	78.4
Males	32	21.6
Total	148	100.0

TABLE 2

Age (years)	No. of Cases
Under 20	3
20–29	18
30–39	20
40–49	33
50–59	34
60–69	23
70–79	7
Unknown	10
Total	148

bladder was removed. Symptoms continued postoperatively.

In the other instance, an error in diagnosis was made in a 56-year-old white woman, who presented with fever, vomiting, leukocytosis and severe right upper quadrant pain and tenderness. Urinalysis was completely negative. A provisional diagnosis of acute cholecystitis was made, and a cholecystogram was obtained the following morning. The gall bladder was not visualized and an exploratory laparotomy was performed. When the abdomen was entered, a right perinephritic abscess was recognized as the cause of symptoms. Although it was realized that the febrile course probably prevented visualization of the gall bladder, malfunction could not be ruled out. Due to the relatively slight sequelae of cholecystectomy, this was performed. The patient was then turned on her side and the abscess drained through a flank incision.

Each of these instances represents an error in the preoperative evaluation of a patient's symptoms and laboratory data. In retrospect, the error in the latter case may have been avoided by an intravenous pyelogram, since a calculus was seen in the roentgenogram. The complete absence of pyuria led to a false sense of security in the diagnosis so that the presence of the renal calculus was dismissed even though it was noted at the time. Although she may have had blockage of the right ureter, her fever decreased merely by draining the perinephritic abscess cavity and administering antibiotics, without any drainage of the renal pelvis being necessary. There was no urinary fistula postoperatively.

Although pathologic conditions of the gall bladder are usually accompanied by stones, this is not always the case, as may be seen in tables 4 and 5. Those instances in which acute cholecystitis without stones was present and cholecystectomy performed, require no further discussion

TABLE 3

Pathologic findings in 148 cholecystectomies

Pathologic Diagnosis	No. of Cases	Per Cent of Total
Chronic cholecystitis (only)	113	76.4
Acute cholecystitis (only)	10	
Acute and chronic cholecystitis	23	
Total number acutely inflamed	33	22.3
No disease	2	1.3
Total	148	100

TABLE 4

Incidence of cholelithiasis in 148 cholecystectomies

	No. of Cases	Per Cent of Total
Cases with stones	135	91.2
Cases without stones	13	8.8
Total	148	100

TABLE 5

Pathologic diagnoses in cases without stones present

	No. of Cases
No disease	2
Chronic cholecystitis	4
Acute cholecystitis (only)	2
Acute and chronic cholecystitis	5
Total	13

except to say that they presented as acutely ill patients and were completely relieved by cholecystectomy. The cases of chronic cholecystitis without stones may be reviewed briefly. There were 3 women and 1 man in this group. The first patient was a 70-year-old white woman, in acute distress due to intermittent colicky pain, who had been ill for 14 days. Cholecystectomy was performed and a tense, thick walled gall bladder found. Clinical impression at operation was acute cholecystitis.

The 2nd patient was a 54-year-old woman admitted because of acute abdominal pain with fever and leukocytosis. She revealed no filling of the gall bladder on x-ray. Other examinations, such as gastrointestinal series, electrocardiogram and serum amylase determination, were negative. Pancreatitis or acute cholecystitis was suspected. Exploration revealed acute pancreatitis with marked pancreatic enlargement and some fat necrosis. Cholecystectomy was performed, the common duct explored and drained by T-tube. The patient was discharged on the 8th postoperative day, after an uneventful recovery.

The 2 remaining cases each presented vague upper abdominal symptoms of distress, bloating and some lower chest pain. Cholecystograms failed to reveal a gall bladder shadow in either case, although one patient, a 63-year-old man, had had several examinations in different hospitals. Cholecystectomy was performed in each instance and both specimens were reported as mild chronic cholecystitis. Of the 4 cases, 3 have had no return of their preoperative symptoms; the 4th, who had pancreatitis, has been lost to follow-up, but to our knowledge has not reentered the hospital.

These cases have been presented in order to demonstrate that although a gall bladder appears relatively normal at surgery, and although it does not contain stones, when laparotomy has been performed on the basis of repeated failure to visualize the gall bladder on cholecystogram, the best probable course of action is cholecystectomy. In no instance in this series, even in the patients in which the gall bladder was normal microscopically, have the preoperative symptoms been worsened by cholecystectomy. In many instances the patient is relieved, as indicated by the last 2 cases without stones and with a grossly normal gall bladder.

Of 148 cases of cholecystectomies, common duct exploration was done in 52 cases, or 35 per cent of the total cases (table 6). This was done on the usual indications of previous history of jaundice, dilated common duct, gall bladder calculi smaller than the cystic duct, findings on palpation of the duct or pancreas that indicated exploration, or acute pancreatitis. Stones were found in the duct in 19 cases, which comprised 36.5 per cent of the ducts explored or 12.8 per cent of the total cases of cholecystectomy. Reoperation for exploration of the duct was necessary in 2 cases (1.35 per cent of the total series). In 1 instance of reoperation for common duct exploration, a cholecystectomy was done in an acutely ill white woman. Although she had recently had jaundice, it was felt that the wisest course at the time of surgery was to stop after cholecystectomy and explore the duct later when necessary, in view of the patient's poor general condition and the edematous nature of the pericholecystic struc-

TABLE 6

Common duct exploration in 148 cases of cholecystectomies

	No. of Cases	Per Cent
Choledochostomy	52	35.1
Common duct stones present (36.5% of those explored)	19	12.8
Reoperation for common duct exploration	2	1.4

TABLE 7

Results in 148 cholecystectomies (10 cases lost to follow-up)

Results	No. of Cases	Per Cent of Total
No further symptoms	120	87.0
Occasional symptoms	8	5.8
No relief of symptoms	2	1.4
Operative deaths	2	1.4
Late deaths (cancer)	2	1.4
Reoperated for postoperative bleeding	1	0.7
Reoperated for common duct stones	2	1.4
Repair common duct stricture	1	0.7
Total	138	100

tures. The duct was explored 3 months later when jaundice recurred.

The 2nd case of reoperation was actually re-exploration of the duct. This white woman was operated for cholecystectomy and common duct exploration, with removal of stones on the first procedure. She remained asymptomatic for 22 months, at which time she became jaundiced so the duct was re-explored and a small pea-sized stone removed from the common duct. Operative cholangiograms were done on this patient following exploration in each instance which revealed no evidence of remaining stones.

The cases presented here may be considered as errors of omission, although it was the better judgment of the surgeon in the first instance to omit common duct exploration at the first operation for the safety of the patient. In the second instance, it might be said that an interval of 22 months without symptoms may indicate that the stones were newly formed, but usually a stone found at second operation has been left behind until proved otherwise.

The common duct was divided inadvertently in 1 case, an incidence of 0.7 per cent (table 7). This occurred during cholecystectomy for acute cholecystitis by tenting the small common duct and mistaking it for the cystic duct. The error was one for which no excuse can be offered. It was repaired at the time of surgery, but secondary repair was required 7 months later due to postoperative stricture. The patient has remained well for 2½ years since the last repair.

In 1 patient (0.7 per cent), re-exploration was required for postoperative bleeding. At the time of the original closure, the operative area was found to be dry to inspection, and on re-exploration, the cystic artery ligature was found to be in place and no bleeding point discovered. An estimated 500 cc. of clotted blood was removed from the gall bladder fossa, the wound again found to be dry, and closed for the second time with no further difficulty. This with the common duct division must be classified as errors of commission, although the actual bleeding point could not be identified in the latter instance.

In 2 cases, cancer was present. A palliative cholecystectomy was done on a 69-year-old white woman who had nonobstructing pancreatic carcinoma with an acutely inflamed gall bladder containing stones. This patient died of cachexia a few months later. The second case was a 72-year-old white woman with an acutely inflamed gall bladder, removed without incident. The pathologist described carcinoma of the gall bladder, which was not recognized at surgery. Even though it was a small lesion, the patient died 6 months later with a markedly enlarged nodular liver.

There were 8 patients in which there was improvement, although symptoms similar to those experienced preoperatively have continued to occur. All of these had cholelithiasis in addition to chronic cholecystitis, but there were no cases of acute cholecystitis in this group. Most of them had chronic nagging symptoms preoperatively, and almost all of them had intermittent attacks of colicky pain, in many instances severe enough to require narcotics for relief. The 2 patients who experienced no relief were the patients in whom no pathologic change was found in the gall bladder. None of the 8 cases described above has developed jaundice.

Patients who have experienced only partial relief may be referred to by some as having a postcholecystectomy syndrome. It is not intended here to discount this syndrome as a clinical entity. In fact, one of the listed cases was excision of a cholecystic remnant which included a stone. The first operation, performed elsewhere, had afforded no relief, but the patient has remained well since the remnant was removed.

SUMMARY

Cholecystectomy may be accompanied by three types of error: preoperative error in diagnosis and evaluation of symptoms, findings and laboratory data, operative errors of omission and operative errors of commission. A series of 148 cases of cholecystectomy is presented and those errors falling into each group are mentioned and briefly discussed. The pathologic findings, incidence of stones, incidence of common duct exploration, and operative errors are presented. The question is raised as to whether in some instances or not the postcholecystectomy syndrome is due to preoperative conditions foreign to the biliary tract that persist in the absence of those symptoms arising from the gall bladder itself.

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LIGATION OF ESOPHAGEAL VARICES: A NEW TECHNIQUE*

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Massive bleeding from esophageal varices continues to be one of the most difficult clinical problems in medicine. This condition, resulting from cirrhosis of the liver in most instances, accounts for approximately 20 per cent of the cases with massive upper gastrointestinal hemorrhage. The hemorrhage may be exsanguinating in nature and, particularly when recurrent, frequently leads to severe derangement of liver function, ammonia intoxication and death. Consequently, on conservative therapy not directed toward either the bleeding varix or the underlying portal hypertension, the prognosis in these patients is extremely grave. Death occurs in 50 to 65 per cent of the cases during the first bleeding episode and 90 per cent of the cases succumb to the disease within 1 year of the first hemorrhage, usually from a complication arising directly from bleeding.[6, 7]

The most effective control of this problem is obtained by permanent reduction of portal pressure by the creation of a portal systemic venous shunt. This procedure can be safely performed in over 90 per cent of the cases on an elective basis in the presence of reasonably good liver function. The mortality rate from shunt operations when performed in unselected cases during bleeding is extremely high because of the poor general condition of the patient, impaired liver function, bleeding tendencies, and the technical difficulties frequently imposed by the edema and induration of the tissues surrounding the abdominal venous channels. The same limitations prevent the routine application of other less definitive procedures such as gastrectomy and esophagectomy.

The generally accepted approach to this problem at the present time is control of the bleeding by more conservative means, and later performing a portal systemic venous shunt, when the patient and his liver function is in reasonably good but not necessarily normal condition. Several nonoperative methods have been employed for this purpose; namely, balloon tamponage and intravenous pituitrin therapy.[1, 4, 5] Currently, balloon tamponage with the Sengstaken-Blakemore tube is the method most frequently employed in an attempt to control bleeding from esophageal varices. Although this instrument will frequently stop hemorrhage from varices, the use of this method alone has been disappointing. Hemorrhage is not always controlled, recurrent bleeding leading to severe hepatic insufficiency and death is frequent, and complications such as pain, ulceration, and respiratory difficulties are not uncommon in these patients. Dilute surgical pituitrin solution when administered rapidly intravenously will, by its arteriolar and visceral arteriovenous constriction action, frequently control bleeding by temporarily reducing portal pressure.[1, 5] Although this method has been successfully employed by some in the control of multiple episodes, recurrence of hemorrhage is frequent and in our experience repeated hemorrhage, even though it may be again controlled, frequently leads to lethal complications.

For these reasons, a more certain but simple method for the control of bleeding is desirable in these cases. Theoretically, this ideal objective may be achieved by surgical ligation of the bleeding varix. Linton[2] has reported the application of transthoracic transgastroesophageal ligation of varices in patients with active bleeding. His results, 80 per cent survival, have been good when compared to the natural course of the disease and the results obtained by nonoperative therapy. Despite these apparent good results, considerable improvement is desired, considering the mortality of 20 per cent in a series selected on the basis of good general condition and reasonably normal liver function. We have successfully used this operation in the treatment of 4 patients with massive bleeding; however, the routine application of this procedure in all patients with continued bleeding from varices

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Presented before the 11th annual meeting of the Southwestern Surgical Society, Denver, Colorado, March 30 to April 2, 1959.

Supported in part by the National Institute of Arthritis and Metabolic Diseases, Grant No. A-2555 A.

has certain limitations. In the first place this procedure may be associated with considerable blood loss, may take a long time to perform, and may be followed by respiratory complications seen with any transthoracic gastrointestinal operation. The general condition of patients with cirrhosis and bleeding esophageal varices frequently does not permit the application of this procedure. Secondly, the source or cause of bleeding is not always apparent in these cases. The presence of liver disease or portal hypertension may not be obvious to suggest the presence of varices, and it is a well known fact that bleeding may be due to duodenal ulcer, gastric ulcer, or gastritis in as many as 20 per cent of the cases even though varices may be present.[3] Under these circumstances, the diagnosis is always doubtful to some extent and one may be reluctant to perform thoracotomy routinely in these cases. The limitations of barium studies and esophagoscopy in the resolution of this doubt is well known. Finally, to add to the dilemma, what does one do when abdominal operation is performed to control bleeding thought due to duodenal ulcer and bleeding is found to be coming from esophageal varices?

Due to the limitations of transthoracic operation and the obvious advantages of abdominal operation in these cases, we were impressed by the possibilities of the transabdominal method of ligating varices described by Welch.[6] This operation consists of exposure and abdominal exploration through an upper midline incision. Other bleeding lesions are excluded or treated. To ligate bleeding varices, the lower esophagus and proximal stomach are mobilized in the diaphragmatic hiatus by blunt dissection and drawn up toward the abdominal incision. A longitudinal incision is then made in the esophagus and extended for some distance down into the proximal stomach, exposing the varices. Each varix is ligated by an over-and-over suture throughout the operative field. The incision in the stomach and esophagus is closed longitudinally in two or three layers and the abdominal wound is closed with stay sutures.

In November 1957 the abdomen was explored in a woman with massive upper gastrointestinal hemorrhage thought due to duodenal ulcer. Abdominal exploration and intragastric exploration by gastrotomy revealed actively bleeding esophageal varices as the only cause of bleeding. An attempt was made to perform the abdominal operation previously described; however, certain difficulties were encountered. The patient was obese and the hiatal region was located deep in the abdominal cavity. The left lobe of the liver was moderately enlarged and stiff. Numerous large, thin-walled veins were located in the region of the proximal stomach, esophagus, and phrenoesophageal ligament. Exposure of this region was extremely difficult and considerable venous bleeding was encountered during attempts to mobilize the esophagus. Consequent to these difficulties, this approach was abandoned. The esophagogastric junction was then exposed from the inside of the stomach, by using the gastrotomy incision previously made longitudinally on the anterior surface of the stomach. The bleeding varix was easily visualized and ligated. This patient survived operation and a portacaval shunt was later performed.

The success of this procedure in the control of bleeding and the simplicity with which it was applied in this case, naturally led to a wider application and a moderate revision of our approach to the problem. This report is concerned with our present general plan of treatment in patients with actively bleeding esophageal varices and a detailed description of the technique of the abdominal operation employed in these cases.

GENERAL PLAN OF TREATMENT

Patients admitted with actively bleeding esophageal varices immediately receive such supportive treatment as blood replacement with fresh whole blood transfusions, vitamin K, and correction of such fluid and electrolyte disturbances that may be present. Immediate operation is not planned routinely, since 40 to 50 per cent of the cases will stop bleeding and survive the bleeding episode. It would, of course, be desirable to select for operation only those who would ordinarily not survive the hemorrhagic episode. This is, of course, impossible during the early stages of the disease when the patient may still have a chance to survive the operation, being spared the results of subsequent repeated hemorrhages. In an effort to exercise some selection in these cases, the hemorrhage causing hospital admission is treated conservatively and operation performed either if the patient does not stop bleeding or if bleeding recurs. At the time of admission a Sengstaken-Blakemore tube is inserted and, without inflating the balloons, the

stomach is evacuated and irrigated copiously with ice water both to remove the blood clots and to produce visceral vasoconstriction. The tube is taped in place without inflating the balloons, attached to suction, and frequently irrigated with ice water. Portal blood pressure is reduced to levels obtained by portal-systemic venous shunts by the intravenous administration of surgical pituitrin as suggested by Kehne and associates[1] and Schwartz and associates.[5] Over a period of 20 to 30 minutes, 20 units of surgical pituitrin, diluted in 200 cc. of 5 per cent dextrose in water, are administered intravenously. If bleeding is controlled, this is repeated every 6 hours for 24 hours. The patient's vital signs, hemoglobin and hematocrit values, and the character of the gastric aspirate are observed, and if at the end of 2 to 3 hours bleeding has not been controlled or if bleeding recurs later, operation is considered indicated. The balloons of the Sengstaken-Blakemore tube are inflated and the tube is placed on traction, which in most cases temporarily controls bleeding, permitting preparation for operation.

TECHNIQUE

The abdomen is opened through an upper midline incision (fig. 1). The presence of large venous channels in the abdominal wound confirms the diagnosis of portal hypertension and immediately suggests esophageal varices as the source of bleeding. The peritoneum is incised to the left of the falciform ligament to avoid the large venous collateral channels extending from the liver to the abdominal wall. The abdomen is thoroughly explored for the various lesions that may produce upper gastrointestinal hemorrhage. Cirrhosis of the liver, splenomegaly, and enlargement of the venous branches of the portal system are characteristic findings of portal hypertension. A longitudinal incision is made approximately 15 cm. in length along the anterior surface of the stomach (fig. 1). Moist skin towels are sutured to the cut edges of the stomach employing a con-

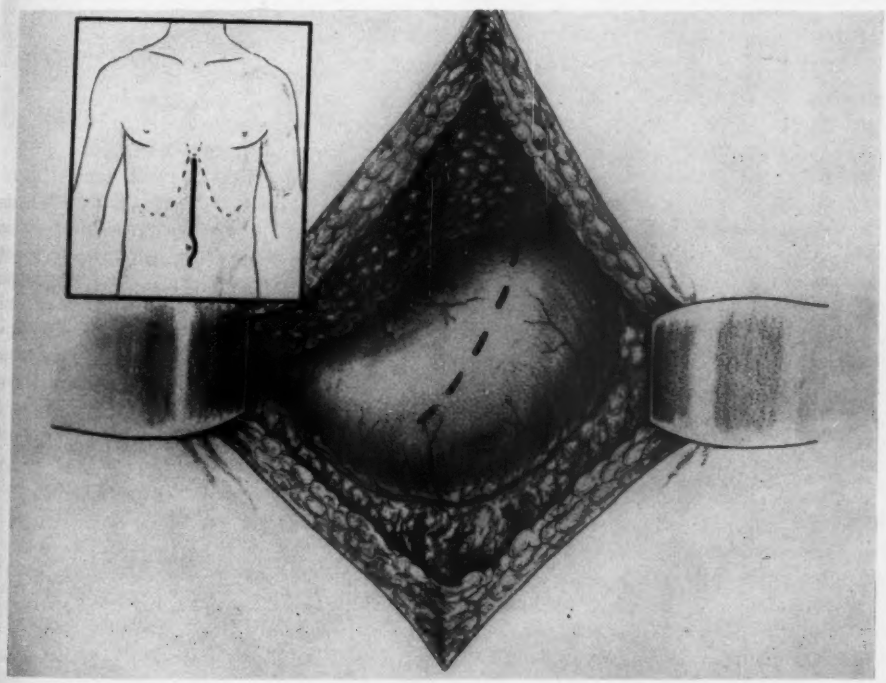

FIG. 1. Diagrams showing upper midline abdominal incision and long longitudinal gastrotomy incision.

tinuous over-and-over suture for hemostasis and to minimize spillage of gastric contents into the abdominal cavity. Blood clots are removed manually, and the mucosa of the stomach is cleansed with saline solution from an asepto syringe and inspected for the presence of gastritis or ulceration. The inside of the first part of the duodenum is inspected and palpated for the presence of duodenal ulcer. If these lesions are found, they are treated by the appropriate operation.

The proximal stomach and lower esophagus are exposed from the inside of the stomach through the gastrotomy incision in the following manner (fig. 2). Two small nasogastric tubes are sutured to the end of the inlying Sengstaken-Blakemore tube. The balloons on the latter tube are deflated and withdrawn by the anesthetist. Thus the nasogastric tubes are brought into place to be used as traction on either side of the esophogastric junction. With gentle traction applied on both the body of the stomach and the nasogastric tubes, the lower esophagus and upper stomach are brought down and upward toward the surface of the abdominal incision. Additional exposure of the esophogastric region is obtained with narrow ribbon retractors. Varices are seen as longitudinal rows of redundant mucosa beginning on the mucosal surface of the upper end of the stomach and extending up into the esophagus. The gross appearance of the disease at this level is similar to that of anorectal hemorrhoids. One or more actively bleeding points have been found in all of our cases very near the esophogastric junction. Although a small peptic ulcer was present at the esophogastric junction in 1 case, bleeding in all instances was from a small mucosal opening communicating with a varix. The bleeding points were located in the stomach just proximal to the esophagus in 5 patients and in 1 patient the site of bleeding was located in the esophagus just above the stomach. Two varices were bleeding in 1 patient and in another patient one varix was actively bleeding and a discrete adherent thrombus was present over a second varix. Vigorous bleeding occurred when this

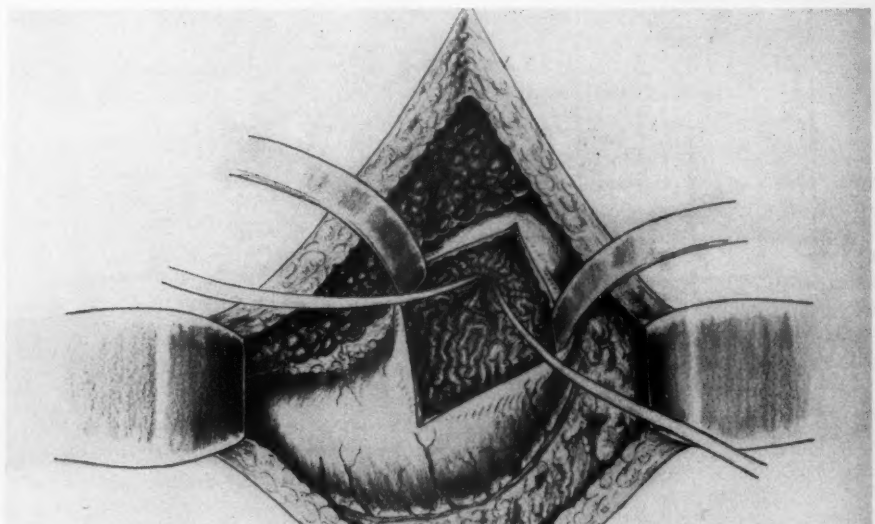

FIG. 2. Diagram showing exposure of upper stomach and lower esophagus from the inside of the stomach.

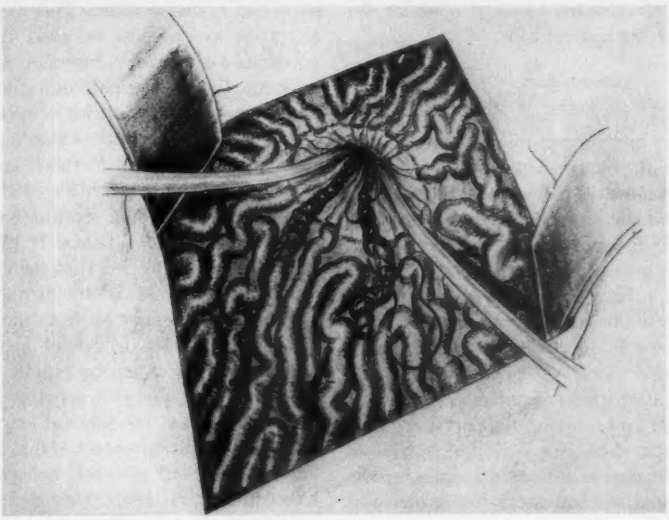

FIG. 3. Diagram showing ligation of bleeding esophageal varices through the gastrotomy incision

thrombus was removed. The lesions in both of these cases were in the stomach just proximal to the esophogastric junction.

The bleeding varix is ligated by first placing and tying a long atraumatic No. 000 silk suture around the varix on the stomach side proximal to the bleeding point (fig. 3). This reduces the venous pressure in the varix and then, by placing gentle traction on the suture, the varix is brought up into view and easily ligated by an over-and-over suture. Traction on the suture is particularly helpful in the exposure of the esophageal segment of the varix. Only these varices which are bleeding or have attached clots are ligated. Small peptic ulcers or erosions are also sutured. Massive ligation of all varices present is not necessary, because the operation is not curative and is designed merely to stop bleeding. A limited ligation further simplifies the operation and does not produce narrowing and difficulty in swallowing. The use of a nonabsorbable, nondigestible suture is considered of some importance in view of the digestive nature of the local enzymes. The nasogastric tubes are removed from the mouth and one large tube is inserted through the nose into the stomach. Neomycin solution (1 gm. in 100 cc. of saline) is placed into the duodenum with an asepto syringe and the gastrotomy wound is closed in layers. The operation is completed by closing the abdomen with retention sutures.

RESULTS

This procedure has now been employed in the treatment of 6 patients with actively bleeding varices. Bleeding was controlled in all cases and 5 patients survived operation to be later submitted to portacaval shunts. Death occurred without signs of subsequent hemorrhage in 1 patient 14 hours after operation. The cause of death, in this patient with mildly impaired liver function, was not evident from autopsy examination. The liver function in 3 patients surviving operation was only mildly impaired, and portacaval shunt was performed within 2 to 3 weeks in these cases. Moderate liver impairment manifested by mild ascites, slight elevation of serum bilirubin, moderate retention of bromsulphalein and 4+ cephalic flocculation were present in 2 patients before operation. Liver function gradually improved in these cases after operation, and portacaval shunts were performed 1 month after ligation of the varices in 1 patient, and 6 weeks in the other. Operation was not withheld from patients with severe impairment of liver function because there was only 1 such patient seen during the period of this study and operation was refused in this case. This patient succumbed to the

complications of repeated bleeding episodes despite the use of the balloon tube.

DISCUSSION

The bleeding that occurs with esophageal varices is prone to recur regardless of the method employed for its control, unless portal vein pressure is permanently reduced. Portal systemic shunts may be employed during the bleeding episode in certain selected cases in good general condition with reasonably normal liver function. Unfortunately, a large percentage of the patients will not fit into this category because of their poor general condition and reduction in liver function. A more conservative approach is desirable in the latter group of patients, permitting improvement in liver function and portal systemic shunt at a later date. We feel that a trial of conservative therapy is indicated for the hemorrhage that caused hospital admission; however, if bleeding does not stop promptly or recurs, bleeding should be controlled surgically by ligating the bleeding point. Abdominal operation is the logical approach in these cases; the diagnosis may be confirmed and other lesions occurring in the gastrointestinal tract, that may be the actual source of the hemorrhage, are more easily handled. Abdominal operation can be performed more rapidly and should be easily accomplished by all abdominal surgeons and, finally, abdominal operation is more easily tolerated than more extensive procedures. In this small series of cases, liver function was reasonably good and it may be for this reason that the majority of cases survived operation. There was, however, moderate impairment in 2 patients who survived, and in view of the simplicity of operation, further trial would appear indicated.

SUMMARY

Bleeding esophageal varices is the cause of approximately 20 per cent of the cases with upper gastrointestinal hemorrhage. The hemorrhage in these cases may be exsanguinating in nature or may precipitate liver failure, ammonia intoxication and death. The prognosis in the natural course of the condition is grave. Death occurs in 50 to 66 per cent of the cases during the first bleeding episode and 90 per cent during the first year. The most effective treatment of this disease is permanent control of the portal hypertension by portal systemic shunt. This procedure is well tolerated in patients in good condition with reasonably good liver function. Unfortunately, liver function or the patient's general condition are frequently poor during a bleeding episode. Under these circumstances bleeding is controlled by more conservative methods and the venous shunt performed later when conditions permit. The bleeding may stop spontaneously soon after admission in some patients. If bleeding is prolonged or recurs, we feel that the varix should be ligated by the transabdominal route to rule out or treat other lesions such as ulcer or gastritis which may be the source of hemorrhage. Abdominal operation can be rapidly performed by all general surgeons and is better tolerated than chest operations. The method employed consists of entering the abdomen through an upper midline incision. The stomach is opened through a long anterior gastrotomy incision. The bleeding points occurring at the esophogastric junction are exposed and ligated through the gastrotomy incision. This type of operation has been employed in the treatment of 6 patients. Bleeding was controlled in all cases, and 5 patients survived and were later submitted to shunt operations.

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BOOK REVIEWS

The editors of THE AMERICAN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.*

Surgical Pathology. By LAUREN V. AKERMAN, M.D. Edition 2. C. V. Mosby Company, St. Louis, Missouri.

Lauren Akerman's *Surgical Pathology* is an excellent textbook. As stated by the author, its purpose is to supplement a textbook in general pathology, and in this respect he has succeeded.

Characteristic gross and microscopic features are stressed, but not belabored. In addition, subtle points which frequently aid in the differentiation of perplexing pathologic processes are brought out. For example, in discussing neuroblastomas he writes, "With better differentiation the tumor cells become larger, the nuclei do not stain so heavily, and between the masses of cells there is cobweb-like material which we have not been able to identify. It does not stain as glial tissue or as fibroglia. The presence of this material between masses of tumor cells is often diagnostic."

Concluding each chapter is a bibliography which is adequate and has been brought up to date. The 1114 illustrations are satisfactory and the chapter on surgical pathology of the eyes and ocular adnexa is new.

The outstanding feature of the textbook is the short and informative clinicopathologic discussions. Written in collaboration with a surgeon, the author has presented the patient's problems with a view toward the prognosis.

The textbook is written in a readable style and is recommended without reservation to all surgeons.

FRANCIS T. ODA, M.D.

Lesions of the Lower Bowel. By RAYMOND J. JACKMAN, M.D., M.S.

The text is divided into two parts. First, the author systematically takes the reader through the well correlated anatomy, physiology, diagnostic techniques and clinical aspects of the normal and the pathologic lower bowel. The second part is a realistic, applicable atlas, in color (75 plates), of the common lesions affecting this region. An additional 56 black and white illustrations greatly facilitates comprehension of the embodied information.

The format and the manner in which the content is presented make this book quite readable and easy to assimulate. The references listed are extensive and, except for an occasional classic, are recent.

The author has succeeded admirably in transmitting his valuable accumulation of knowledge and experience to others through this logical, concise presentation.

JOHN M. ALLEN, M.D.

Cancer—Diagnosis and Treatment. Edited by JOHN B. FIELD, M.D., Ph.D. 776 pp., $18.50. Little, Brown & Company, Boston, 1959.

This book is intended for medical students. It is divided into 20 chapters; each chapter, written by a different author, deals with one of the important groups of human tumors. Additional chapters are devoted to carcinoma in children, chemotherapy of cancer, and radiotherapy of cancer. In general, the book gives a good but summarized account of the cancer problem today.

As in many books written by several authors, this book has chapters of uneven value. The chapters which excel in quality and in amount of information are:

Chapter 6: Tumors of the stomach; Alton Ochsner and Charles C. Abbott

Chapter 7: Tumors of the small intestine, liver, gallbladder, bile ducts, and pancreas; Max Thoreck

Chapter 8: Tumors of the colon, rectum, and anus; Fred W. Rankin and A. Stephens Graham

Chapter 11: Tumors of the male generative tract; Willet F. Whitmore, Jr.

Chapter 16: Neoplastic diseases of the lymphatic system; Henry Jackson, Jr.

Chapter 18: Cancer in children; A. Leonard Luhby and Joseph R. Wilder

Reading of some of the subjects is of little use, even for students, due to the paucity of information given, such as in tumors of the oral cavity, larynx and pharynx, and radiotherapy.

In summary, the book is a fair compendium of oncology, written for medical students. Some of the subjects are not developed enough as to be able to convey the necessary information to make the problems understood. Throughout the book there is very little information about treatment by radiotherapy.

FERNANDO G. BLOEDORN, M.D.